

BOOM ABODES

By: Benjamin J. Davis



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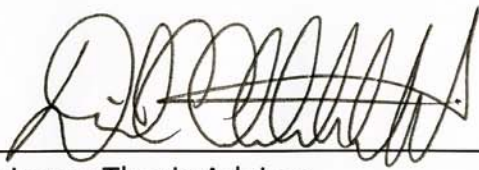
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A Design Thesis Submitted to the
Department of Architecture and Landscape Architecture
of North Dakota State University

By:

Benjamin J. Davis

In Partial Fulfillment of the Requirements
for the Degree of
Master of Architecture



Primary Thesis Advisor



Thesis Committee Chair

May, 2011
Fargo, North Dakota

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Abstract

With recent technological advances in oil extraction, communities across the Midwest are being hit by an oil boom. With a rapid growth of migrant workers flooding in to rural counties, economic strain and housing shortages threaten small communities. This thesis will examine the necessities of a rural community in North Dakota to cope with the oil boom and propose a temporary housing development to aid communities during transition. The housing system will be self-sustaining in nature, capable of functioning in various terrains. Considerations in climate, local resources and adaptability will be thoroughly researched to produce an efficient and reliable housing solution.

Key words: Oil Boom, Rural Communities, North Dakota, Temporary Housing, Self-sustaining

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problem **statement**

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Problem Statement

Can a housing system be designed to cope with the rapid mass housing demand of an oil boom in rural North Dakota and be maintained or removed when the boom subsides?

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statement **of intent**

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Statement of Intent

TPOLOGY:

Temporary housing development

THE CLAIM:

Without proper development and planning, an oil boom community is at risk of an economic failure.

ACTOR: community

ACTION: development and planning

OBJECT: oil boom community

MANNER OF ACTION: proper, appropriate

THE PREMISES:

A community experiencing or anticipating an oil boom can be severely burdened if they are not prepared.

A rural town must take appropriate action to plan and develop adequate housing for migrant workers flooding into their community in order to protect its existing housing market and economy.

A community's population may be multiplied during an oil boom and with an influx in citizens comes an increase in housing demand.

A thoroughly composed development strategy is necessary to protect the community during a period of transition.

THEORETICAL PREMISE/UNIFYING IDEA:

An architecture that can meet the rapid housing demand of migrant workers and either accommodate their families for prolonged residency or be disassembled and relocated for future use, will greatly enhance the sustainability of a community.

PROJECT JUSTIFICATION:

With the current oil boom in North Dakota it is evident there is a need for a housing solution. In the event of an oil boom, a rural community must properly plan and prepare for a rapid change in its population and economy. Careful consideration must also be made for the period of time following the oil boom in order for the community to maintain itself.

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thesis **proposal**

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Narrative

North Dakota, a state that many people around the country can not recognize or locate, is now flourishing with prosperity in a time of recession due to a recent **oil boom**. This is due in part to new technologies that have made it possible to drill and extract oil from locations once unreachable. With national unemployment at its highest since the Great Depression, **North Dakota** has the lowest rate in the country. People across the country are being laid off and finding jobs in the North Dakota oil industry.

Ironically as the unemployment rate drops, the homeless rate climbs, increasing almost 20% in some areas in only a single year. **Rural communities** have experienced three-fold population increases since the beginning of the oil boom in 2006. With an increase in population comes an increase in housing demand. The high demand for housing in rural communities is driving the prices of rent and mortgages exponentially higher. With high wages in the oil field the new immigrant population can afford to pay amounts that many locals can not. This is forcing original residents to leave their houses and apartments because they can no longer make ends meet.

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Narrative

To prevent turmoil from occurring in a community there needs to be proper organization and planning. Most importantly, an effective solution to the housing demand must be produced. If the housing demand is satisfied it will reduce inflation in the community. In the event of rapid migration, there is a need for temporary housing until permanent residences are available. The temporary housing must not only accommodate the rural workforce but also their families. By creating hospitable environments for the families, an additional workforce is provided to the community to fulfill the supporting jobs which come as a result of an expanding population.

In addition to satisfying the housing demand, the community must also generate the required infrastructure to support the new population. This thesis will research the necessary development of a self-sustaining temporary housing community in rural northwestern North Dakota and develop a strategy for its implementation, thus minimizing the need for long-term infrastructure.

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The primary objective of the temporary housing development is to provide a place for a migrant workforce to live. It will also provide relief to an oil boom community while its population is expanded and housing accommodations are needed. The housing units will be designed to be temporary, but encompass capabilities of extended use in either their current location or an alternate location. Disassembly of the housing units makes relocation achievable and efficient.

The primary users of the housing development will be oil field workers. Many of the oil field workers will have families, who will be accommodated as well. Due to the various number of occupants inhabiting the housing units, the design will be flexible to adapt to individual needs. The housing units are modular in nature, manufactured from 100% recycled or recyclable materials, and provide easy maintenance and repairability. The units will be designed as simply as possible allowing for easy construction and assembly in the field.

The temporary housing development and all of its elements can be purchased or leased by oil companies or other rural workforce companies from the manufacturing company. The individual units could then be purchased by or leased to the users. Following the initial 'boom' sequence, the temporary housing design might then be used for emergency relief or in military environments. In the case of this thesis, the housing development will serve as an aid to a new population transitioning from temporary housing to permanent residences.

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Major Project Elements

The temporary, self-sufficient housing development will include several unique elements. An implementation plan for development including distribution, deployment, maintenance and mobility of the elements will be critical to its effectiveness and efficiency.

Dwelling Units: Living quarters will be designed for a varying number of occupants and contain traditional living spaces. Emphasis will be placed on making the living arrangements accommodating for families as well as individuals.

Administration unit: An administration unit will be designed to provide workstations, a bathroom, a kitchenette and other necessary components for management of the housing development and all its elements.

Community Center: A community center will provide the residents of the development with spaces for social interaction and recreation. A flexible design will allow the community center to be used for a variety of functions.

Water and Sewage Treatment Center: All wastewater on site will be transported to a water and sewage treatment center through an internal infrastructure where it can be processed and reused.

Transportation: An efficient transportation system will be developed to allow mobility throughout the housing development. The transportation design will aim to have minimal impact on the site and be removeable when it is no longer needed.

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Site Information

Stanley, North Dakota, located in the upper midwest of the United States, will serve as the main focus of the project. Stanley is a rural town in the epicenter of an oil boom and experiencing drastic impacts to its economy, infrastructure and community dynamic.

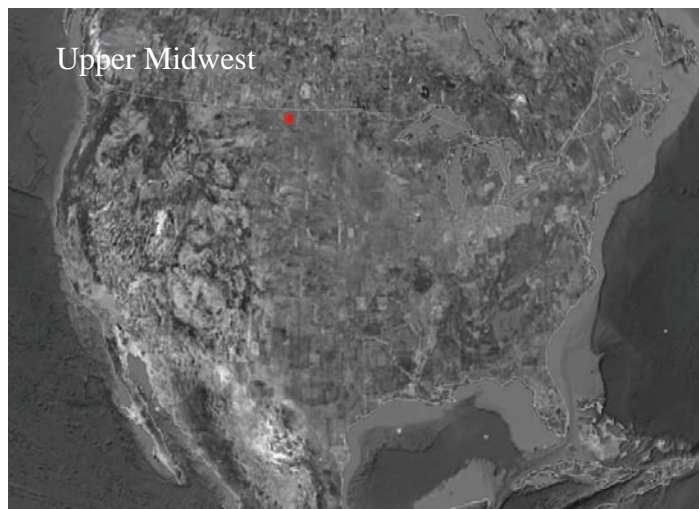


IMAGE 1

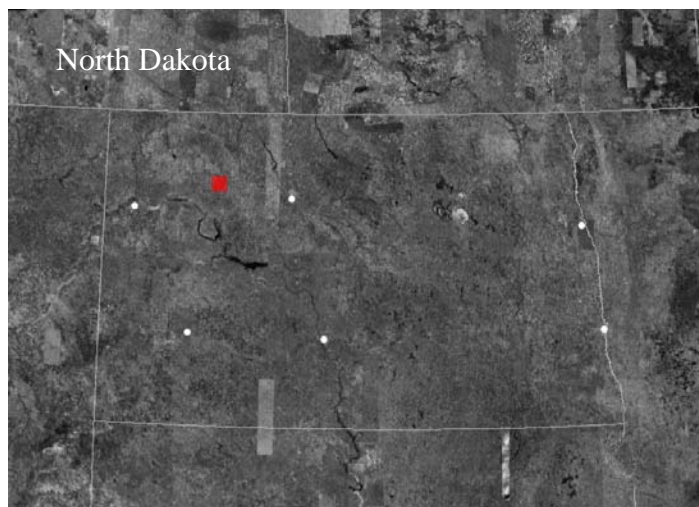


IMAGE 2

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Site Information

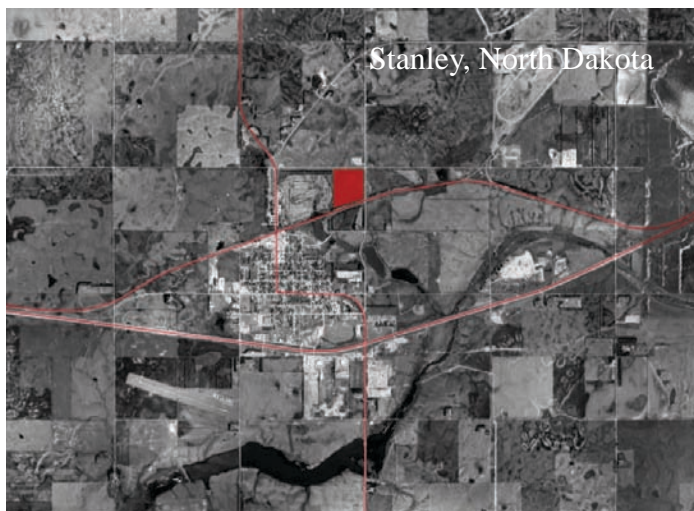


IMAGE 3

The site is located on the northern outskirts of Stanley. Transportation links to Stanley include the Amtrak train as well as North Dakota Highway 8 and U.S. Highway 2 which intersect just south of Stanley.

The Amtrak goes directly through Stanley on the north side of town, providing an efficient transportation method for the oil field workers to commute between the larger cities of Minot to the east and Williston to the west.



IMAGE 4

The site is buffered from the city by a plot of tree rows and the Amtrak tracks to the south. To the west of the site is Prairie Rose Golf Course and to the north and east are paved roads and fields.

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Project Emphasis

The emphasis of this thesis will be to provide a temporary housing development to accommodate oil field employees and other rural workforces. The project will embody a self-sufficient approach in an effort to relieve rural communities of an overwhelming population increase of migrant workers.

The temporary housing will exist with little or no aid from outside infrastructure, making it able to be implemented anywhere there is a demand. Construction methods and materials will be examined to produce a housing system which is not only easily and efficiently assembled and disassembled, but also directly reusable for future application. Sustainable products and systems will allow for the generation of renewable energy and make self-sufficient living possible.

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designing for the transition *A Plan for Proceeding*

RESEARCH DIRECTION: Extensive research will be conducted in a quantitative and qualitative manner. The research will be conducted in the following fields to generate a further understanding: unifying idea, project typology, historical context, site analysis, and programmatic requirements.

DESIGN METHODOLOGY: Research for this thesis will be conducted using the mixed-method quantitative and qualitative approach. All data collected will be used to implement a concurrent transformative strategy guided by the unifying idea. In regards to the unifying idea, this strategy will guide my research so that quantitative and qualitative data will be gathered concurrently and continually integrated in order to produce appropriate outcomes. Analysis, interpretation, and reporting of data will occur throughout the research process and will be presented with both text and graphics. Direction for the research will be driven by the unifying idea as well as the project typology and emphasis.

DOCUMENTING THE DESIGN PROCESS: The design process will be documented in a variety of media. A general sketchbook will be used throughout the process for schematic, concept and detail sketches as well as analysis and note taking. Photography will also be used to document all physical models and other research and design elements. All design process documentation will be digitized as it is created and stored on jump-drives and DVDs for protection, organization and availability. The spring semester will lead the project from research into the production phase. The final presentation of the thesis will consist of a verbal presentation, presentation boards and physical models. A final, professionally bound and printed book will be produced documenting all phases of the design and research process and be made available to future scholars in both hard copy and

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designing for the transition *Design Studio Experience*

First Year Studio:

Spring Semester 2007 – Stephen Wischer
Form and Spatial Studies
A Dwelling for...
Hand Graphics

Second Year Studio:

Fall Semester 2007 – Mike Christenson
Tea House – Fargo, ND
Minneapolis River rowing club – Minneapolis, MN
Spring Semester 2008 – Mike Christenson, Malani Srivastava
Casa Gaspar Volumetric plaster casting
Live/work Community Design and Courtyard casting

Third Year Studio:

Fall Semester 2008 – Cindy Urness
Center for Excellence – Fargo, ND
Lake Agassiz Regional Library – Moorhead, MN
Spring Semester 2009 – Ron Ramsey
Shaker Barn Renovation – New Lebanon, NY
Chicago Concierge Hotel – Chicago, IL

Fourth Year Studio:

Fall Semester 2009 – Darryl Booker
Mixed-Use High-rise – San Francisco, CA
KKE percussion instrument competition
Spring Semester 2010 – Frank Kratky, Paul Gleye, Darryl Booker
Slum Redevelopment project-Santo Domingo, DO
Marvin Windows Design Competition, Livingston
School – Tanzania, Africa

Fifth Year Studio:

Fall Semester 2010 – Steve Martens
Adaptive Use project – Fargo, ND
Spring Semester 2011 – David Crutchfield
Thesis

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program
document

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research
results

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Research Results

If you are from North Dakota or the Midwest United States, you have more than likely heard of the Bakken Shale Formation, which are oil-rich layers of dolomite and shale within the Williston Basin. Exploration of the Bakken has resulted in thousands of oil wells being drilled by migrant workers from across the country. The influx of population has brought new challenges to rural communities; most significantly, a demand for housing. With a national economy in recession, oil companies are thriving by pushing production to the limit with the resources they have available. Rapid development of the oilfield precedes development of communities at a rate they are incapable of matching. This imbalance creates challenges which this program will investigate. The housing crunch, water shortage, over-capacitated infrastructure, and societal impacts are among the issues I will analyze in my research and address in a proposed architectural solution.

During times of economic hardship across the country, people are desperate to find work and willing to sacrifice family, commute great distances, and live in compromising conditions. The United States recorded a national unemployment rate of 9.6% in October of 2010, well above the North Dakota rate of 3.6%, which marks the lowest in the country (Schneider, 2010). Oil companies provide the capability of finding high-paying employment within a day or two, easily attracting people laid off during an economic recession. License plates from all across the country and Canada can be seen in oilfield communities like Stanley, ND. With populations multiplying, communities need a system to allow for a period of time in which the city can develop.

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Research Results

Western North Dakota is facing a huge obstacle when it comes to the housing market. With the oil and energy developments providing more jobs than towns have homes for people to live in, many are going homeless. With such a high demand for housing, the prices of homes, apartments, and hotel rooms have increased significantly to rates higher than major metropolitan areas. One-bedroom houses rent for up to \$1,500 a month, three times what they were five years ago (Koumpilova, 2010). Mortgage prices are inflated, forcing longtime residents not benefitting from high oil pay to sell their homes and move in with friends or relatives. Home prices are increasing at a rate of more than 10 percent annually (Koumpilova, 2010).

Oil companies have come through many towns in the western half of North Dakota, booking entire floors in motels long-term and other available spaces to be converted for housing. The Painted Horse, a 41-unit motel in Stanley has been booked for three years. Companies are also buying mobile homes and offering to help with housing down payments and other assistance to attract employees. Additionally, some companies are setting up clusters of trailers for workers only, called 'man camps'. Contrasting emotions from longtime residents come with the development of man camps. Some people would rather preserve the slow, quiet community where they can let the kids run without fear of oil industry trucks. In contrast, there are many people who value the oil boom, the influx in population, and the stimulated economy. Ultimately, with the rate at which the oil industry is moving, change to the communities and their environments is inevitable.



IMAGE 5



IMAGE 6



IMAGE 7

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IMAGE 8

The man camps are intended to be self-sufficient developments on the outskirts of town, where workers can eat, shower and rest after long shifts in the oilfields. Northeast of Stanley is the largest man camp anywhere in the oilfield, with rooms for 350 workers and a dining facility. The city is reviewing plans for two more camps, one south of town near the airport and one in town (Koumpilova, 2010).



IMAGE 9



IMAGE 10

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Research Results

Transformations all across the area are taking place in response to the housing demand. Major developers as well as local business owners are taking advantage of the opportunity to help struggling communities. The Frosty Treat, a small restaurant in Stanley, has sectioned off parts of its operation to provide housing to six truck drivers (Koumpilova, 2010). An old Stanley hospital left vacant since the construction of a new health center in 2002 is being renovated into 17 apartment units. The project is funded by a \$100,000 grant from the North Dakota Housing Finance Agency (NDHFA) which is an institution dedicated to making housing available and affordable to all North Dakotans. “Without adequate housing for its workforce, a community cannot grow and prosper,” said Mike Anderson, NDHFA executive director.

An assortment of new oil-related companies are establishing themselves in the region including Multi-Chem, an oilfield chemical company, locating a three-acre warehouse and office in Stanley to serve as a hub for regional activity. EOG Resources also located its multi-purpose rail facility in Stanley along with the Pecan Pipeline Company, which opened an office in the middle of town. Businesses like these remind us that not all of the new work in the oil industry is in the oilfield. Many jobs are created in town which may branch out to a different demographic.

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Research Results

Prefab

Prefabricated construction can provide an efficient and timely solution during the implementation of the housing community. In an event when speed of construction is crucial to meet the high demand for shelter, prefabricated construction is an extremely effective method.

Water Demand

As oil and gas development accelerates, water is going to become a bigger issue. Drilling in the Bakken Formation requires two to four million gallons of water and two million pounds of sand per well, along with 800-1,000 trucks to complete a well. Producing one barrel of oil from the Bakken requires at least four barrels of fresh water. It is estimate that oil and gas production from the Bakken Formation will use up to 5.5 billion gallons of water annually for as long as two decades (Kellman, 2010).

The advanced drilling technique of hydraulic fracturing, better known as “fracking,” makes the extraction of oil in the Bakken Formation possible. Fracking uses large quantities of water and sand combined with a chemical fracturing fluid to break through the shale and sandstone layers where the trapped oil can then be extracted. It is estimated, at maximum drilling rate, there will be a need for 23 million gallons of water per day to hydraulically fracture the wells.

Farmers are becoming concerned about the oil industry's excessive water consumption because they rely on groundwater for their livestock and irrigation. Recent droughts have begun drying up stock ponds. As water in the dry plains of North Dakota is becoming scarce, the state is considering using water recycled from sewers and wastewater treatment plants to frack oil and gas wells. Diesel fuel is also being examined as a possible fracking component.

School

After trying to work out an arrangement with some new housing units in town and realizing the cost of rent was unfeasible for the average teacher, the school district decided to build two duplexes to house new teachers. Despite the large paychecks and availability of employment in the oilfields, the graduation rate still remains above 98 percent, proving young adults still realize the benefit of a college education. The oilfield has brought a new diversity to the population of Stanley, broadening kids' perspectives of new ideas and a larger world. Other rural communities that had been closing schools and consolidating are also seeing an influx in student population (Koumpilova, 2010).

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North Dakota is a state which was last in almost every category economically before the oil boom happened. Since the beginning of the boom the development and economic stimulation of the oil industry had made the state almost recession proof as the rest of the country has slipped into deficit (Hutton, 2009).

Convenience Store

The Cenex convenience store in Stanley has been streaming with the traffic of oilfield workers day and night since the start of the oil boom. Providing everything from fuel, food, clothing, cash machines and showers, the store is a popular stopping point.

The steady flow of oil, sand and water trucks passing through has made expansion of new pumps, parking, a kitchen and bathroom facilities a necessary investment. The convenience store serves as a social connection between the longtime local residents of Stanley who work there and the new migrant population (Fundingsland, 2010).

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Research Results

Sociology

The oil development has helped to boost the population of the state as well as rural communities in western North Dakota. According to the state Job Service, more than 7,000 laborers have migrated to North Dakota to work in the oil and gas fields (Schneider, 2010). With production and development of the oil industry accelerating, that number will continue to grow as housing becomes more available. Stanley has experienced a significant population increase, comprised of primarily male oilfield workers. This change has created an interesting impact on the community's social atmosphere. Previously in the small town, women outnumbered men, but it is quite evident that the social dynamic has turned. Only 10 years ago, the town's population of 1,280 people had approximately 100 more women than men. With hundreds of oil workers moving to the area, the competition for available women in town has created tension.

Some neighbors in small communities have circulated petitions to have proposed man camps and mobile home parks rejected or relocated. They weary of the idea of forty or fifty or hundreds of new neighbors and strangers moving in across the road or around the corner. They worry about their roads being further destructed, the implications on their sewer system and their peace being disrupted by rowdy oil workers.

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research **summary**

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Research Summary

In my research I investigated the various impacts and implications an oil boom has on a community. The characteristics of the oil industry as well as a rural town in North Dakota were explored. The relationship between the two is a very interesting interaction including acceptance, bitterness and animosity.

It is clear that in an oil boom, a community undergoes significant change. Changes occur in the economy, the infrastructure, the population, the culture, and the environment. Many of the changes are beneficial, while some are unfavorable.

The city needs homeowners and families to come who will remain residents of the community after the drilling subsides. The man camps are housing as many people as they feasibly can. What the man camps cannot do is cater to the families of the workforce they house. It is understandable that the oil companies do not want to provide housing to those outside of their operation. The transition from temporary housing to long-term arrangements is what a boomtown needs to better secure its future.

The cities cannot grow and prosper after the oil drilling subsides if they cannot provide housing for families. If adequate housing is available to the families of the many oilfield workers, than a whole new workforce is created in the community. This also establishes a degree of permanence to the population and a source of security to the community.

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Research Summary

There is often uncertainty during a natural resource boom due to the unpredictability of demand for the resource to sustain for a long period of time. The uncertainty makes communities apprehensive to rush into development. It is evident that the community development in western North Dakota was slow to start when the current oil boom began in 2006. This is undoubtedly due to the misfortune Williston underwent during the 1980s oil boom. At a moment's notice the entire oil drilling operation halted and Williston, which invested millions of dollars into development, was left with a debt which took them 20 years to recover. As towns delayed in preparation for the vast amount of migrant workers coming to the area, a housing crunch quickly took shape.

This is evidence of the importance of a flexible system which can sufficiently accommodate a housing demand while not permanently investing the community. The system should meet the needs of an expanding population and allow for an effective transition from temporary to permanent residences. Self-sufficiency is important as to not rely on the infrastructure and utilities of a city during its time of expansion. Transportability and ease of deployment are also critical to a smooth operation.

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case **studies**

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designing for the transition *Case Studies*



Modular Dwelling Unit **40**



Green Horizon **44**



Pod Trading **48**

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Case Studies



IMAGE 11

MOBILE DWELLING UNIT

Project Type: Mobile Dwelling Unit (MDU)
Designer: LOT-EK
Client: Global Traveler
Function: Portable Housing
Location: Major Metropolitan Areas

Designed by LOT-EK, the Mobile Dwelling Unit (MDU) is a portable housing solution utilizing an industrial shipping container that can easily be transported to meet its owner at their next destination. Fully equipped with live and work amenities, the MDU is a home away from home for the individual or couple looking to travel the world (Scoates, 2003).

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Case Studies



IMAGE 12



IMAGE 13

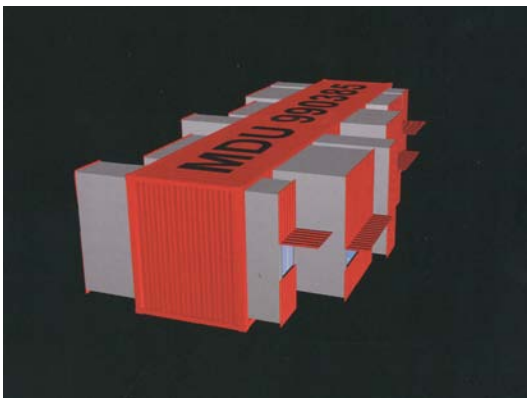


IMAGE 14

LOT-EK is a New York-based architecture studio founded in 1993 by two Italian-born architects, Ada Tolla and Giuseppe Lignano. LOT-EK takes an innovative approach to their design construction, materials and space through the use of existing objects and technology. They pull large, industrial, ready-made objects from our urban fabric such as aircraft hulls, shipping containers, tanks, mixers, refrigerators and sinks to create an architecture of unique experience. LOT-EK takes obsolete artifacts of industry and alters them in a way in which they may sustain life and activate experience.

MDU Mobile Dwelling Unit by LOT-EK consists of the adaptive use of shipping containers. They are designed to be a home away from home for individuals moving around the globe. The MDU travels to the individual's destination complete with all live/work equipment and containing the dweller's belongings.

The exterior walls of the shipping container are cut to generate extruded subvolumes, each of which house a live, work, or storage function. When the MDU is in use, the extruded subvolumes are pushed out, leaving the interior of the container void of any obstruction and providing access to all functions along its sides. The functions are arranged to work in pairs across from one another.

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Case Studies

When traveling, the subvolumes are pushed in, occupying the entire container volume and leaving the exterior skin flush and back to its standardized dimensions for worldwide shipping. Once the MDU reaches its destination by rail, ship, or truck, it is loaded into MDU Vertical Harbors located in all major metropolitan areas. The Harbor consists of an eight-foot wide, multilevel steel rack into which the MDUs are supported and secured. The MDUs are hoisted into position by a crane which slides on tracks the length of the Harbor. Once in position, the MDUs are plugged into the existing systems including power, data, water and sewage. The Harbor is in constant transformation as MDUs are loaded and unloaded from the permanent rack.

Conclusion:

This case study speaks more to the portability of a temporary home for the world traveler. The nature of the shipping container is heavy, durable and of a standard dimension. LOT-EK's plan for transportation of the MDU is efficient and allows for delivery to individual locations or to one of the vertical harbors in any metropolis around the world. The MDU uses every volume within the container to its full capacity by use of built-in furniture. The MDU is designed to house 1-2 people but possesses the potential to be stacked or combined with other units to form larger-scale dwelling units. Socially, LOT-EK takes an interesting approach to their design in which they "attempt to blur the boundaries between art, architecture, entertainment and information; a rethinking of the ways in which we interact with industrial and technological culture of our world" (Tolla, 2002).

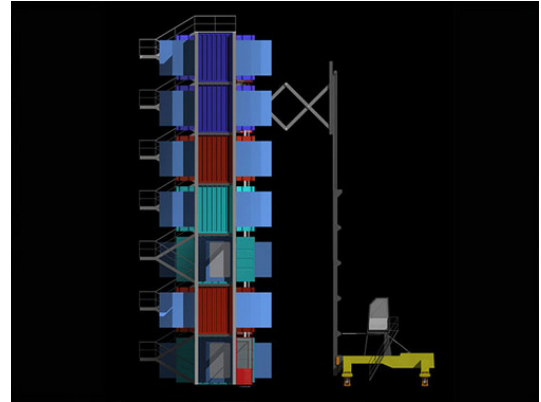


IMAGE 15

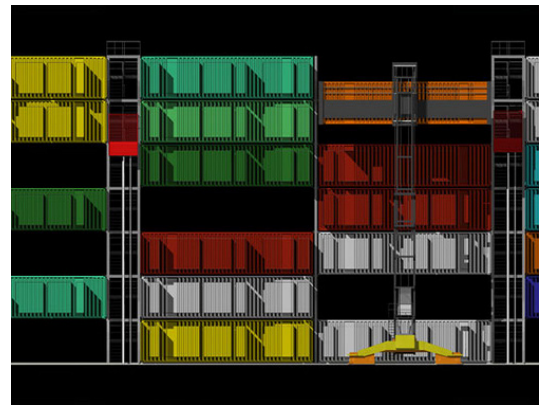
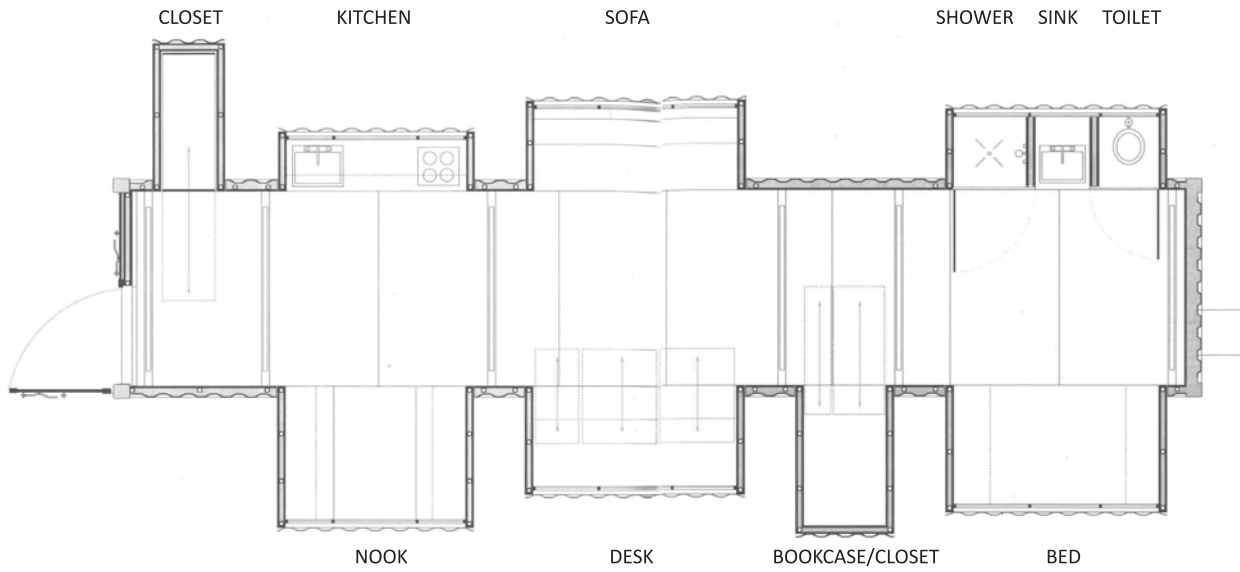


IMAGE 16

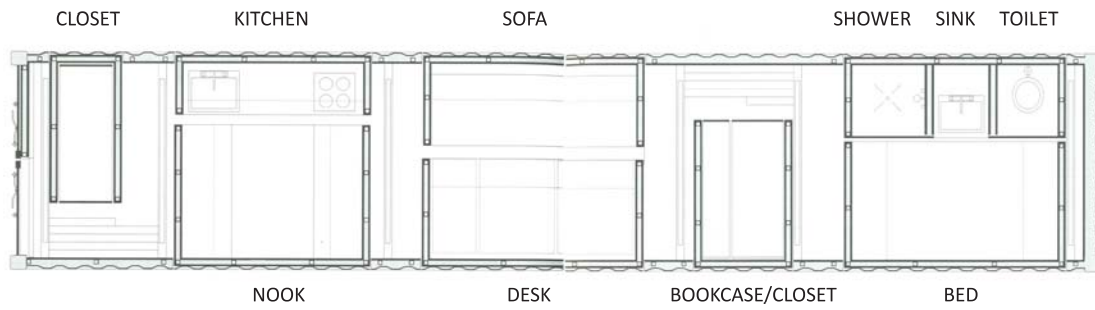


IMAGE 17

OPEN PLAN



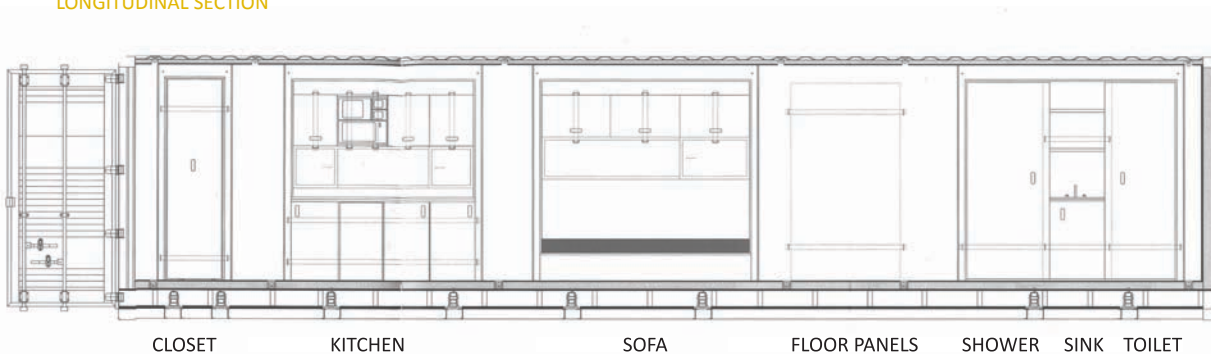
CLOSED PLAN



LONGITUDINAL SECTION



LONGITUDINAL SECTION



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Case Studies



IMAGE 22

GREEN HORIZON

Project Type: On-Demand, Self-Sustaining Housing
Designer: Green Horizon Manufacturing LLC
Client: Single Family
Function: Disaster Relief Housing
Location: Distributed Worldwide from San Francisco, CA

Green Horizon Manufacturing has designed an on-demand, self-sustaining housing solution to be used worldwide. The structures are designed as single-family temporary homes with the primary purpose of disaster relief and emergency response (Digital Horizons, 2010).

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Case Studies

Green Horizon Manufacturing is an emerging leader in on-demand, self-sustaining housing and commercial facility solutions. Their products are configurable for a multitude of housing, commercial and utility applications. The company is based out of San Francisco, CA where its manufacturing facility is located at the Port of Stockton. A coastal location allows the company to deploy its products overseas to areas in need with relative ease. Green Horizon is also connected with a network of domestic and international distribution facilities, enabling rapid deployment of their structures.

Green Horizon supplies structures that are designed for an array of emergency and temporary housing applications; from single-family relief homes and mobile medical units, to community centers and water filtration units. In the absence of utility connections, Green Horizon units are capable of completely self-sustaining for up to one week without an existing infrastructure. Units are also integrated with utility connections and may be networked as part of a central hub.

Green Horizon utilizes modular construction in the fabrication of all the components of its structures. This allows for repair or replacement of damaged components or panels. All structures are designed with 100% recycled or recyclable materials. Each unit has integrated solar panels in the roof and wastewater storage capabilities as well as grey water processing (Digital Horizons, 2010).



IMAGE 23

ROOM ABODES

designing for the transition

Case Studies

The structures are designed to be fully transportable and are built with an integrated towing system, as well as the ability to collapse to fit in a standardized shipping container. Installation of the units can be accomplished by two people with no building experience in about an hour and all necessary equipment and materials are shipped within the structure itself.

In the case of Green Horizon, the solution is similar to others in the way that it is a temporary and transportable dwelling to be used for disaster relief and emergency response. Green Horizon differentiates itself by proposing a viable solution for self-sufficiency. The ability to provide necessary life-supporting elements in the event where utilities are non-accessible is imperative. Each unit includes a triple-power generator for electricity, built-in battery system, 800-gallon water supply, water filtration system, grey and black water holding tanks, along with standard RV connections. The mobility and adaptability of the structures provide flexibility to go virtually anywhere in the world (Digital Horizons, 2010).

Conclusion:

Green Horizon shows how a structure can fully support life, even if temporary, in the wake of a disaster. They do this by implementing existing survival technologies into a single unit which can be deployed in a rapid and efficient manner anywhere in the world.



IMAGE 24



IMAGE 25



IMAGE 26



IMAGE 27



IMAGE 28

ROOM ARODES

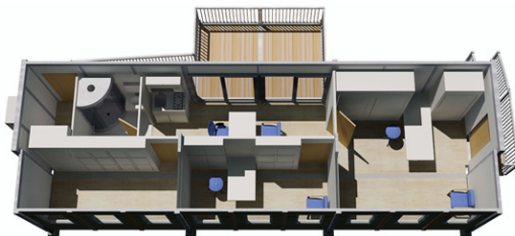
designing for the transition *Case Studies*



SINGLE FAMILY HOME



ADMINISTRATIVE UNIT



MEDICAL UNIT



COMMISSARY UNIT



COMMUNITY CENTER



BUNK HOUSE UNIT



COMMUNITCATIONS UNIT



WATER PURIFICATION & STORAGE UNIT

IMAGE 29-36

ROOM ABODES

designing for the transition

Case Studies



IMAGE 37

MOBILE DWELLING UNIT

Project Type:	Modular Housing
Designer:	Pod Trading
Client:	Public and Commercial Residential
Function:	Housing
Location:	Worldwide

The POD is a single-level dwelling unit constructed on-site of modular prefabricated parts. The contemporary design and construction techniques address the needs of a rapidly changing market. The POD is designed with flexibility to adapt to a wide range of regional and climatic conditions with only minor modifications to the structure and environmental systems (Pod Trading, 2010).

ROOM ARODES

designing for the transition

Case Studies



IMAGE 38



IMAGE 39

Pod Trading is a family-owned and operated business formed in 2008 in response to the humanitarian needs resulting from recent natural disasters. The POD is a flat pack accommodation solution which provides a new standard of building design. A variety of Pods create building types to accommodate a range of applications in both public and private sectors. A range of single, double and triple POD layouts are available in addition to Camp Ground PODs and Aged Care Living PODs.

Speed of construction is an issue closely addressed by Pod Trading. A time frame of only seven days is required for an unskilled labor force to erect a finished Pod. This eliminates construction delays and additional expenses by removing up to 12 trades from the process. The services required following the supply of the flat pack are a general builder, a plumber and an electrician.



IMAGE 40

1. High levels of roof, wall and floor insulation
2. Light external color to reflect solar heat
3. Large external window and door openings for natural ventilation
4. Roof mounted solar panels
5. All openings weather sealed
6. High level windows
7. Galvanized water tanks
8. Large eave overhangs
9. Comfort plus glass to all glazed openings
10. Deck to act as an external living area

ROOM ABODES

designing for the transition

Case Studies

Additionally, the Pod structures are built with strength to resist wind, flood, fire and earthquakes. Durability is achieved by the use of quality and technologically-advanced materials adaptable to any climatic condition. Minor modifications to the structure and environmental systems can be made to tailor a Pod to different climates.

The Pod building differs from other pre-fabricated and transportable buildings because it uses a flat pack means of transportation. This allows the structure's floor plate to be larger than other transportable buildings, which are limited by the regulations of road transportation. Larger floor plates also provide flexibility in layouts and floor plans.

The Pod incorporates a passive energy efficient design, unlike most other modular buildings, by the use of eaves, adequate ventilation and insulation. Convenient setup of rainwater tanks as well as options in solar hot water or solar/wind power are available.

Conclusion:

This case study shows ways in which a modular structure can be prefabricated ahead of time and delivered and constructed on-site in an efficient manner. The numerous components of the Pod allow for flexibility in site adaptation and climatic suitability. The Pod also allows for versatility in adapting to a range of sizes and uses.



IMAGE 41



IMAGE 42

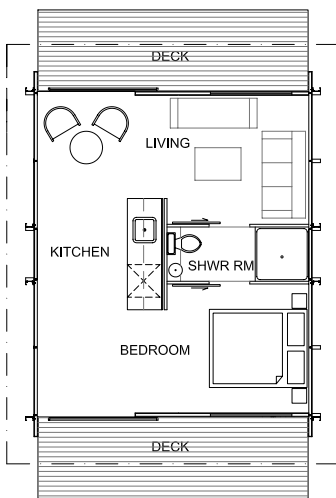


IMAGE 43

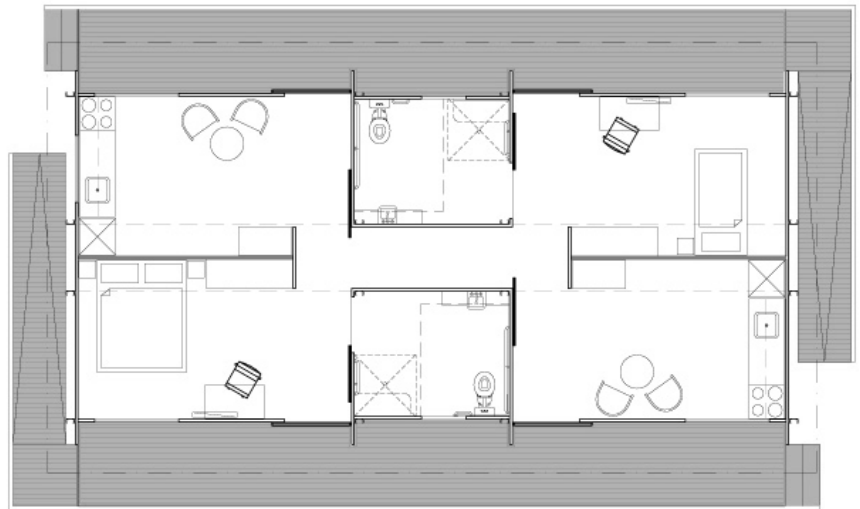


Elevations

IMAGE 44

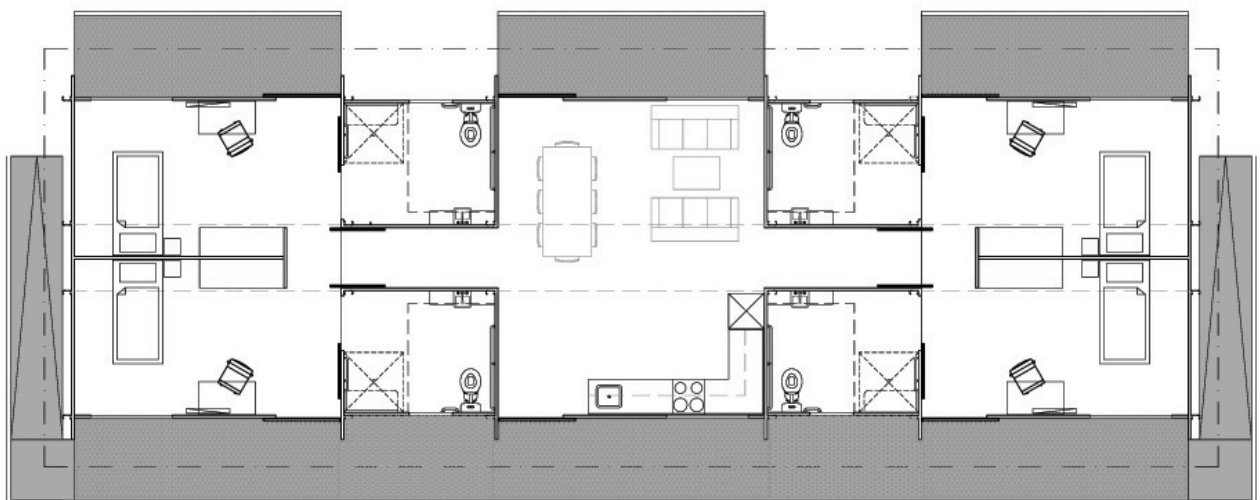


Double Pod



Double Pod

IMAGE 45



Triple Pod Aged Care Unit

IMAGE 46

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Case Studies Summary

This series of case studies was directed at understanding a specific building typology. Three examples of temporary and portable housing solutions were researched: the Mobile Dwelling Unit by LOT-OK, an On-Demand Housing Solution by Green Horizon Manufacturing, and the POD by Pod Trading.

The unifying idea for this thesis lies in the proposal to provide temporary housing to migrant workforces, which can relieve cities of an overburdened infrastructure. The three explored case studies each contribute a unique value to the research of a temporary and portable building typology.

The case studies provide evidence of architecture that can be transported in an efficient and timely manner. In the case of the MDU by LOT-EK, the solution to incorporate the entire living unit into a single shipping container provides efficiency in transportation due to the universal standard dimensions of the unit. Once at its destination, the MDU is loaded into a permanent Vertical Harbor using an on-site crane which slides on its own rails the length of the harbor. Similarly, the Green Horizon solution to temporary housing is also designed using a scale in accordance with standard shipping and transportation methods. The units may be compressed to fit inside of a shipping container for transportation by sea, rail, or truck; the unit also has its own trailer hitch allowing for transportation without a shipping container by heavy-duty pickup truck. Contrary to the previous two cases which are transported in a fully constructed state and require minimal setup, the POD uses a flat pack delivery method in which the structure is sold in kit form and assembled on-site. Although the construction process is slightly longer, the POD's flat pack system of delivery and modular building allows for a large and entirely flexible floor plan, adaptable to suit program needs and site conditions.

Each of the case studies caters its design differently to suit an individual, multiple individuals, a single family or a larger group of residences. The MDU layout is designed to facilitate one or two individuals in a compact living environment. The Green

ROOM ARODES

designing for the transition

Case Studies Summary

Horizon unit adequately serves a single family of six people in a comfortable fashion in addition to facilitating a wide range of services to support a community in need. Green Horizon structures can also be integrated into a self-sustaining Community Hub, sharing resources for long-term use. The POD provides the most flexibility in size, with units that can be added or subtracted, adapting the layout to accommodate a range of occupants from the individual to the multi-family.

All three projects deal with their social and cultural context in a unique way. The MDU is directed toward the modern-day nomad, traveling the world while never leaving their home behind (Scoates, 2003). Loaded and unloaded into the Vertical Harbors, the MDUs create a constantly transforming environment. The Green Horizon units are designed to service the demands of disaster response. They aim to provide a healthy housing solution at a moment's notice to victims of natural disaster. Pod Trading's goal is to respond and contribute to the reconstruction of communities, providing humanitarian needs to those affected by recent natural disasters (Pod Trading, 2010).

A common theme among the Green Horizon and POD cases is their lack of site specificity. Both of the housing units are designed to adapt to a variety of sites and climatic regions. Additionally, both cases emphasize a reduced reliance on services and infrastructure. The Green Horizon units include enough water, food, bedding, personal hygiene supplies and electricity to supply six people for up to one week. Although the MDU possesses the capacity to be transported virtually anywhere, it is designed to be facilitated by the site-specific Vertical Harbors located at major metropolitan areas around the world, and where they are plugged into all systems including power, data, water and sewage.

Researching these case studies has provided significant information which will prove to be of great worth in the design of my project. Each case offers unique and invaluable insight pertaining to the project typology, theoretical premise and unifying idea resulting in a more comprehensive investigation.

BOOM ABODES

designing for the transition

historical
context

BOOM ARODES

designing for the transition *Historical Context*

- 1916 - Pioneer Oil and Gas Company drilled near Williston but came up with only water.
- 1923 - Des Lacs Western Oil Co. drills failed wildcat wells.
- 1937 - A California oil company drilled and gave up at 10,000 feet.
- 1951 - On April 4th, Amerada Petroleum Company discovered oil on the Clarence Iverson farm near Tioga. Amerada drilled 11 dry holes before striking oil at 12,000 feet.
- 1952 - In November, the one millionth barrel of oil in North Dakota was produced.
- 1953 - Amerada built Beaver Lodge, an oil camp in Tioga for 150 people.
- 1953 - Construction began on pipeline from Tioga to Mandan.
- 1966 - Marked the peak of the drilling with 27 million barrels coming from 1,965 producing wells.
- 1978 - Oil boom began in western North Dakota.
- 1986 - World oil prices fall below \$10 a barrel and North Dakota oil boom goes bust.
- 1990 - Crude oil price in North Dakota fell as low as \$3 a barrel.
- 1999 - Low oil prices, and for the first time since 1951, no oil rigs were drilling new wells anywhere in the state.
- 2006 - Modern day oil boom in North Dakota.
- 2007 - 54 oil rigs drilling in the North Dakota fields.
- 2010 - In December, there are a record 165 ND oil rigs drilling and oil is at \$88.42 a barrel.

ROOM ABODES

designing for the transition *Historical Context*

Main Street in Stanley, 1900-1915



IMAGE 47

Town of Stanley, 1908



IMAGE 48

Great Northern Depot and grain elevators in Stanley, 1908



IMAGE 49

ROOM ABODES

designing for the transition *Historical Context*

Settlement in Mountrail County

Fur traders and ranchers were the first settlers in the early 1800s of what is now Mountrail County. The Lewis and Clark expedition passed through the southern boundary of the county along the Missouri River in 1805. Five different Indian tribes inhabited the area when settlers arrived. Reservation boundaries were established and changed on two separate occasions allowing for more homesteaders to come to the area. In 1908, the present boundaries of the county were established and Stanley was made the county seat. The population of Mountrail County was 13,544 people by the 1930s but began to decline due to drought and economic depression.



Tourist camp in Stanley, 1940s

IMAGE 50

BOOM ABODES

designing for the transition

Historical Context

Oil Discovery

The discovery of oil in North Dakota dates back to 1951 when a crew of 12 men working for Amerada Petroleum Company struck oil on the Clarence Iverson farm, 8 miles south of Tioga and about 25 miles west of Stanley. The successful drill came after nearly two dozen failed wildcat attempts.

That event marked the birth of an oil field which grew to become the region known as the Williston Basin, under which lies the Bakken Shale Formation, encompassing an area from central Montana to central North Dakota, and from South Dakota to western Canada. The U.S. portion of the formation is described as the country's largest oil deposit outside of Alaska, including the largest and most accessible part in Canada. The Bakken Shale could prove to be one of the largest oilfields in the world. The United States Geological Survey found the formation to be 25 times larger than previously assessed in 1995. The oil reserve is the largest continuous oil accumulation ever assessed by the USGS (Kellman, 2010).



IMAGE 51



IMAGE 52

Clarence Iverson #1 well and the man himself



IMAGE 53

Williston Basin and Bakken Shale Formation

Dedication of the Clarence Iverson
#1 oil well on October 25, 1953



IMAGE 54

ROOM ARODES

designing for the transition *Historical Context*



IMAGE 55

Signal Oil and Gas Refinery
in Tioga, ND, 1955



IMAGE 56

Burying the pipeline from Tioga to
Mandan, 1955



IMAGE 57

Standard Oil Co. Refinery
in Mandan, ND, 1956

BOOM ABODES

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Historical Context

1980s Oil Boom and Bust

During the oil boom in 1980, the population of Mountrail County was 7,679, and in that year Stanley was the largest town with 1,631 people.

In the 1980s when oil showed promise, the city of Williston invested more than \$20 million to build streets and sewers for new subdivisions which were to house the newly-acquired population. Mobile home parks were developed in response to the housing demand, and between two of the parks, 650 units quickly filled with migrant oilfield workers within two years (Koumpilova, 2010).

In the mid-1980s when the price of oil plummeted so low that it was no longer economically feasible to extract the oil, the boom went bust and Williston was left in debt. Though oil companies knew the oil was there, they figured it was best to keep it stored in the ground until the price of oil recovered. At the time it was cheaper to buy foreign oil than to drill in North Dakota.

The two privately-owned mobile home parks were cleared out by developers and were eventually surrendered to the city along with \$5 million of debt. Not long after, the newly developed parks had overgrown with weeds. Also, many developers who began building housing and infrastructure in the Williston community left town, leaving the community with more than \$20 million in bad debt (Koumpilova, 2010).

Today several mobile home dealerships have opened offices in Williston, and according to the state Department of Health's food and lodging division, more than 25 new RV parks have been developed since the fall of 2009. Most of the parks are at full capacity and many are doubling up RVs to sewage hook-ups and electricity.

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Historical Context

Temporary and Portable Architecture

The idea of temporary and portable architecture is not something new, but has been around since people started building structures. Hunter-gatherers used portable buildings as they needed to move year-round to ensure their supply of food. Nomadic shelters such as the yurt, igloo and tipi provide great examples of temporary and portable housing.

The yurt is a lightweight, strong, warm and easy to heat structure consisting of a circular wooden frame and a durable fabric cover. The yurt is highly efficient at maximizing strength while minimizing the use of materials. It can be placed on a block foundation which doesn't scar the land and can be easily moved with the seasons.

The igloo is another example of a temporary shelter which is constructed predominately by the Inuit people of Canada's Central Arctic and Greenland. The igloo fully embraces the local material of compacted snow to build habitable spaces. The compacted snow traps air within itself to create a reliable insulator.

The tipi is a conical structure constructed of animal skins or birch bark and long poles by the Native American tribes. The multiple poles are arranged in a circular shape and faced together at the top before being wrapped by a detachable cover. The tipi is durable and conducive to a range of climatic conditions. It can also be disassembled and reconstructed quickly, making it efficient for tribes when relocating.

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thesis project
goals

BOOM ARODES

designing for the transition

Thesis Project Goals

ACADEMIC

The academic goal of this thesis project is to generate a product based on a theoretical premise and unifying idea that is progressive and relevant in the advancement of architecture today.

This project will examine the methodologies of how a housing development is produced in a boomtown and propose a new way of transitioning from the temporary to the permanent. To reach a unifying solution, all elements within the statement of intent must be thoroughly examined and understood.

This project also aims to design a solution which is adaptable in that it meets the demands and needs of a culture today as well as into the future. An architecture that is flexible in adapting to change and can withstand the test of time is what makes architecture truly sustainable.

The production of research, ideas, proposals and resources are to be documented and published to provide a tool of study, accessible to all who wish to advance the development of the topics investigated in this thesis.

PROFESSIONAL

The professional goals sought after with this thesis project are primarily concerned with the quality of the design and means in which it is achieved. The work performed should be done at a professional level, illustrating my abilities relevant to a career in architecture.

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Thesis Project Goals

Presentation of the thesis should be clear, concise and graphically engaging throughout my project.

It will be vital to my success in finding employment to progress my knowledge, skills and understanding of both AutoCAD and Revit. As many firms continue to use AutoCAD and slowly adapt to Revit, both programs demand a necessary level of competence.

PERSONAL

My personal goal for this thesis is to create a product using all my skills and abilities to their fullest capacity in an effort to develop the finest product possible.

The exploration of personal interests and beliefs is something that should never be lost in the design process and development.

As this thesis marks the end to my long formal academic career, I hope for this to be my premiere project, one which I can look back upon with the utmost pride as I continue into my professional career in the field of architecture.

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designing for the transition

site **analysis**

ROOM ARODES

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Site Analysis

Located just inside the city limits of Stanley, the site lies tucked into the northeast corner of the developed area. The site is currently occupied by an agricultural crop field, as is the surrounding area to the north and east. Directly to the west of the site is the Stanley Prairie Rose Golf Club and to the south the Burlington Northern Santa Fe Railway. The site is buffered from the city by these existing elements, thus providing separation while maintaining proximity for the convenience of the residents. Remaining located within city limits will make the transition from temporary housing to permanent housing more efficient.



IMAGE 58

ROOM ABODES

designing for the transition

Site Analysis



IMAGE 59

The site is relatively flat with some gently rolling hills resulting in very little elevation change. Although a very minor change, the center of the site has the highest point which is important to the site water runoff and will likely influence the layout of my design.

Gravel roads border the site to the north and east, separated by a low-lying drainage ditch. Access to the site is offered by both of the bordering roads. A tree row creates the site boundary and a separation from the golf course to the west. The site is quite peaceful despite the constant passing of large oil field pickups and semi-trucks always reminding one that they are in oil county.

Although the goal is for the housing development to be self-sufficient and off the city grid, the site has access to both city water and electricity. Minimal alteration will be done to the site in the design of the architectural solution as it will be designed to function as temporary in a variety of locations. Furthermore, the focus will be toward the flexibility and adaptability of the development to a variety of climates and terrains.

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Site Analysis

Water and Wind

There is no standing water on site. A water runoff pond is located south of the golf course.

The site is relatively wide open offering little protection from the prevailing northwest winds. With an average of about 13mph wind speeds, the site has potential for small wind power generators.

Light Quality

The site offers great potential for natural daylight and views as it is wide open with only medium and small-sized trees bordering the north, south, and west perimeters.

Vegetation

The site is occupied by an agricultural crop field. The north perimeter of the site is lined with the largest trees, while the south and west perimeters are lined with smaller trees and overgrown vegetation.



IMAGE 60



IMAGE 61

ROOM ABODES

designing for the transition *Site Analysis*



IMAGE 62



IMAGE 63



IMAGE 64

ROOM ARODES

designing for the transition *Site Analysis*



IMAGE 65-71

BOOM ABODES

designing for the transition

Site Analysis



IMAGE 72

The BNSF Railroad to the south has a regularly scheduled train passing. Stanley also has an Amtrak station which services an average of 12 passengers daily. The railroad can serve to transport residents and also provides a potential source of transportation for building materials.



IMAGE 73



IMAGE 74

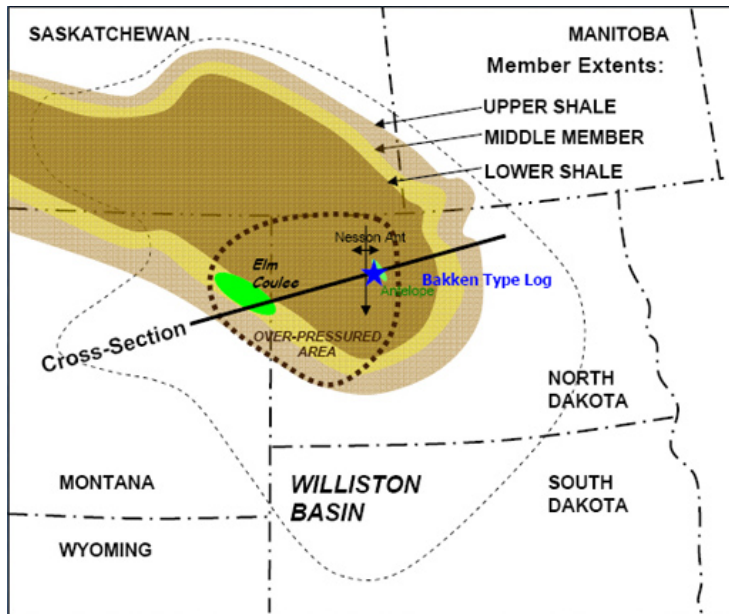


IMAGE 75

ROOM ARODES

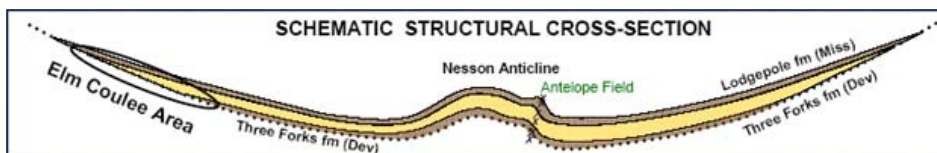
designing for the transition

Site Analysis



Bakken Shale Formation

IMAGE 76



Site Character and Distress

There are no signs of erosion, muddy water or dying trees on the site. There are no existing structures on the site and aside from agricultural development of the land, the site shows little distress in the way of human activity.

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Site Analysis

Topography and Soil

The soils in Mountrail County lie on till plains and moraines which make up 85% of the county. Most of the area is used for range and cultivating crops, and some is used for pasture. About 56% of Mountrail County is cropland. The site has a slope ranging from 4% to 8%. The soil is a Fine Sandy Loam which offers adequate drainage on site.

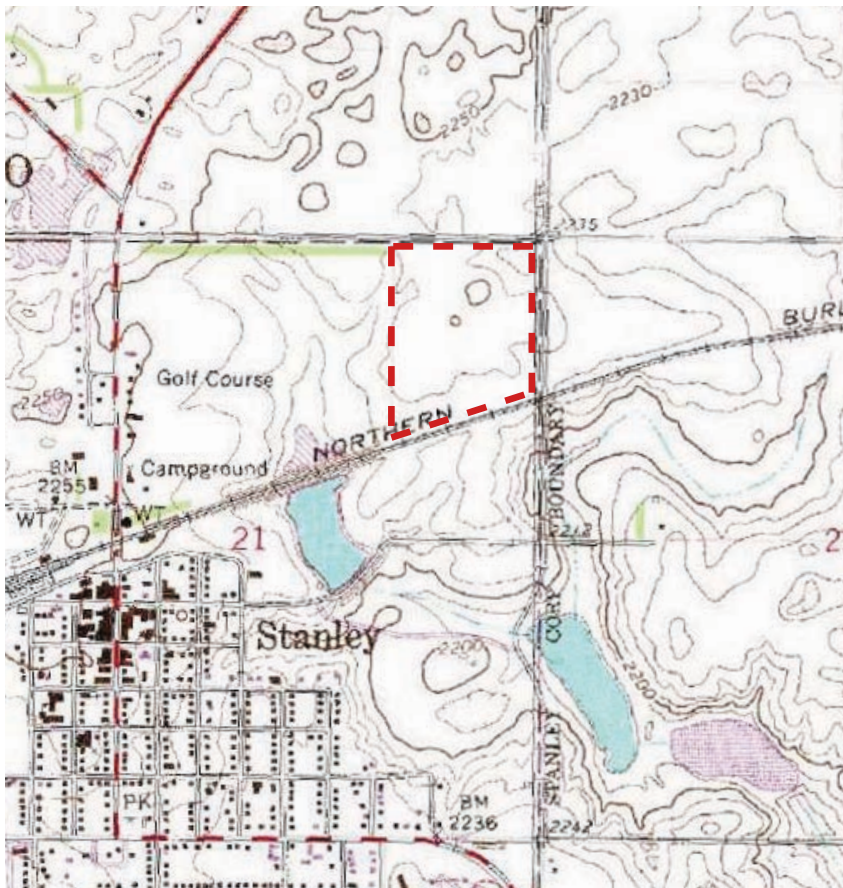


IMAGE 77

ROOM ARODES

designing for the transition *Site Analysis*

Vehicle and Pedestrian Traffic

There is frequent traffic from oilfield trucks passing on both of the bordering roads to the north and east. There is no pedestrian traffic on the site. The nearest pedestrian traffic is on the golf course east of the site.

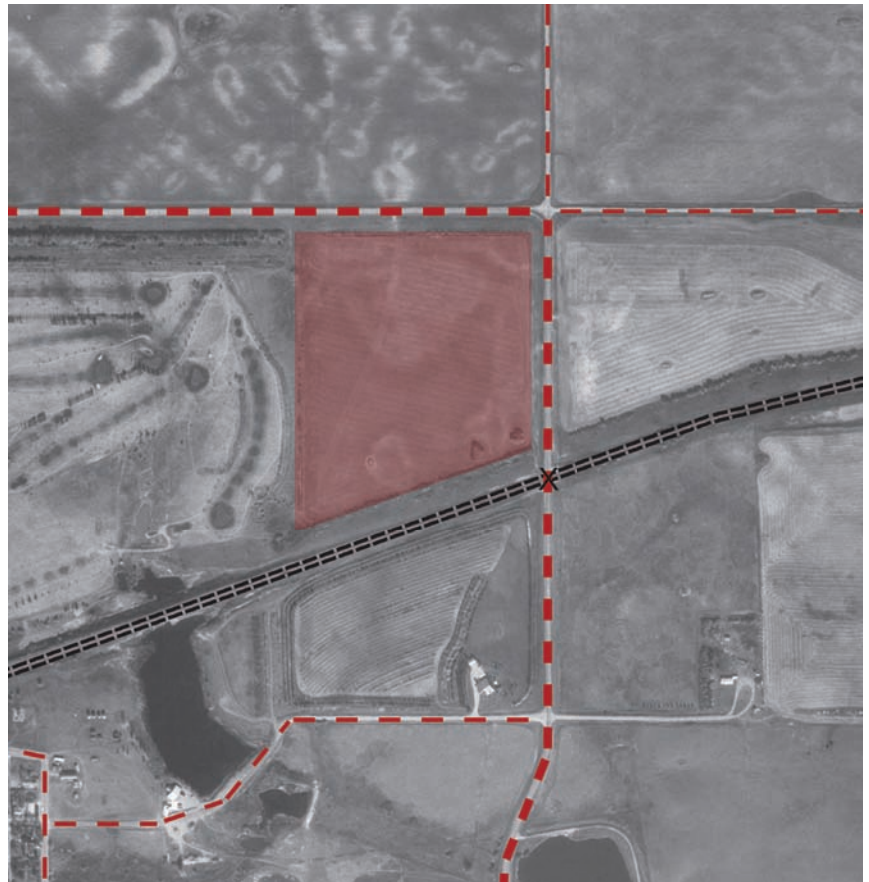


IMAGE 78

BOOM ABODES

designing for the transition *Site Analysis*



IMAGE 79

Utilities

There are two fire hydrants on the site, in the northwest and northeast corners. Also, power lines run east and west along the north edge of the site. Although the site is within city limits and these utilities are available, my design will aim to function as self-sustaining.



IMAGE 80

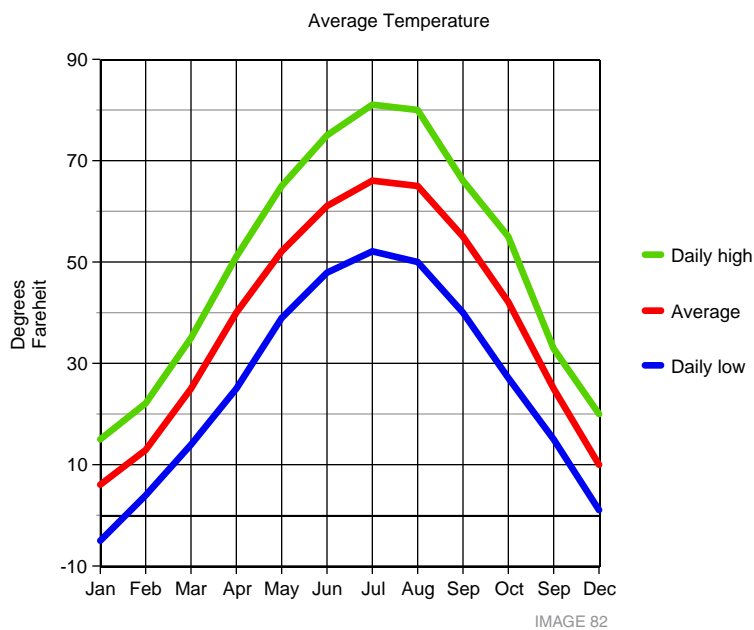


IMAGE 81

ROOM ARODES

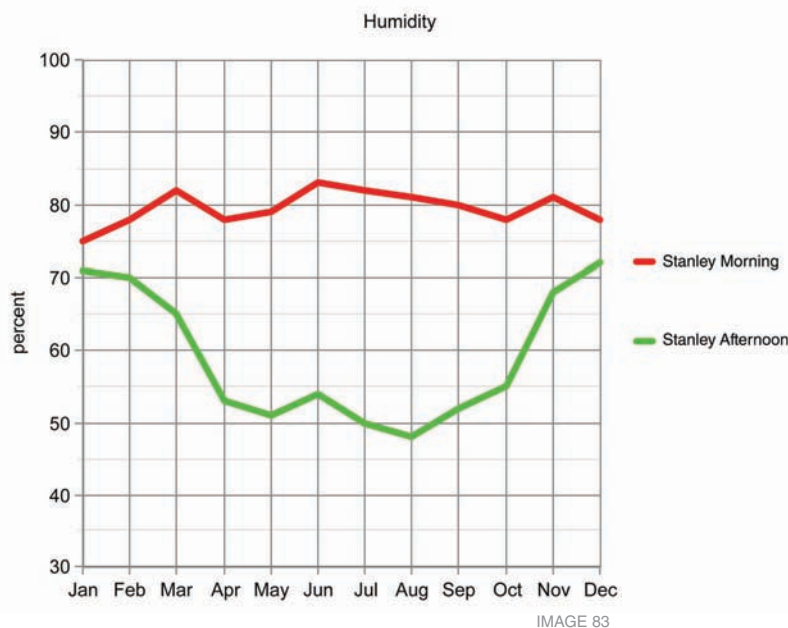
designing for the transition

Site Analysis



Temperature

The graph depicts the annual average temperature for Stanley, ND. Average high and low temperatures are also shown. The climate in Mountrail County is usually warm in the summer with frequent spells of hot weather and occasional cool days. The county has very cold winters as the arctic air surges over the area.



Relative Humidity

The graph depicts the annual average relative humidity levels for morning and afternoon in Stanley, ND. The average relative humidity in midafternoon is 55%.

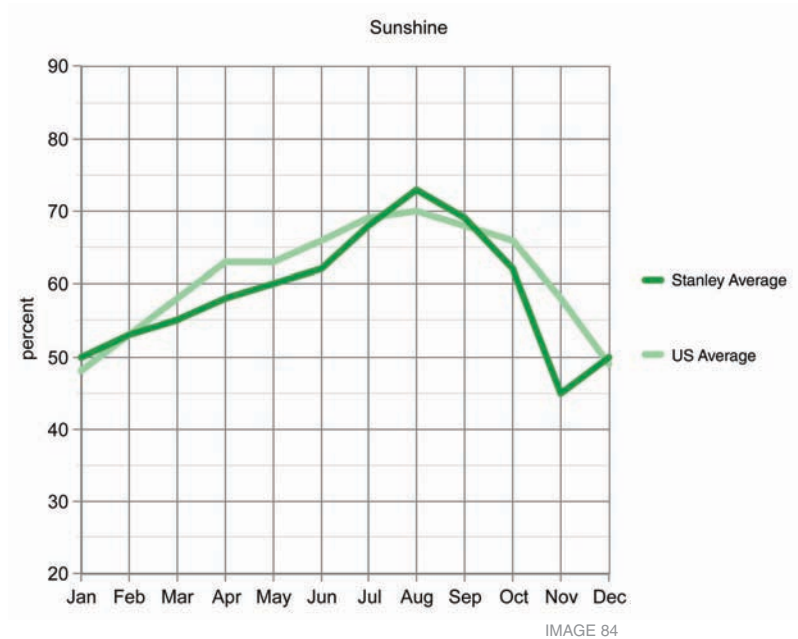
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Site Analysis

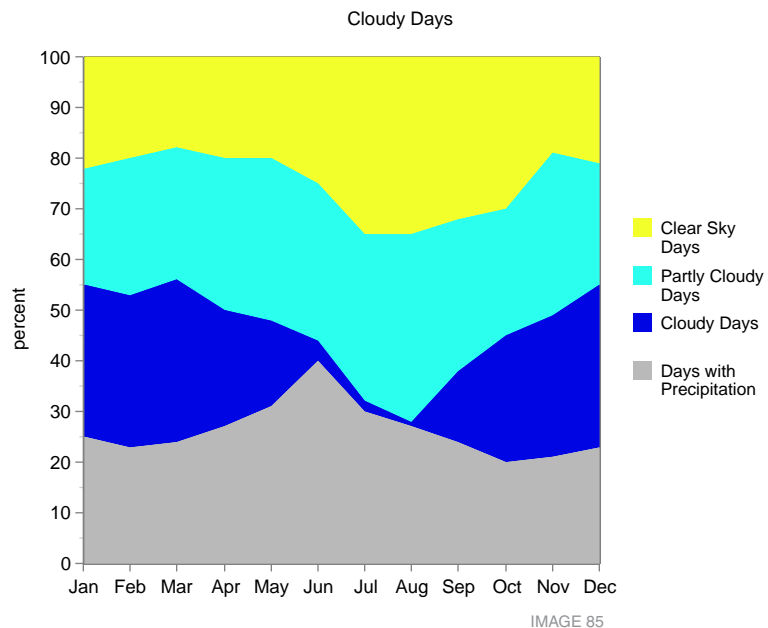
Sunshine

The graph depicts the percentage of sunshine in Stanley, ND compared to the U.S. average. The average summer temperature is 65 degrees F with an average daily maximum temperature of 79 degrees.



Cloudiness

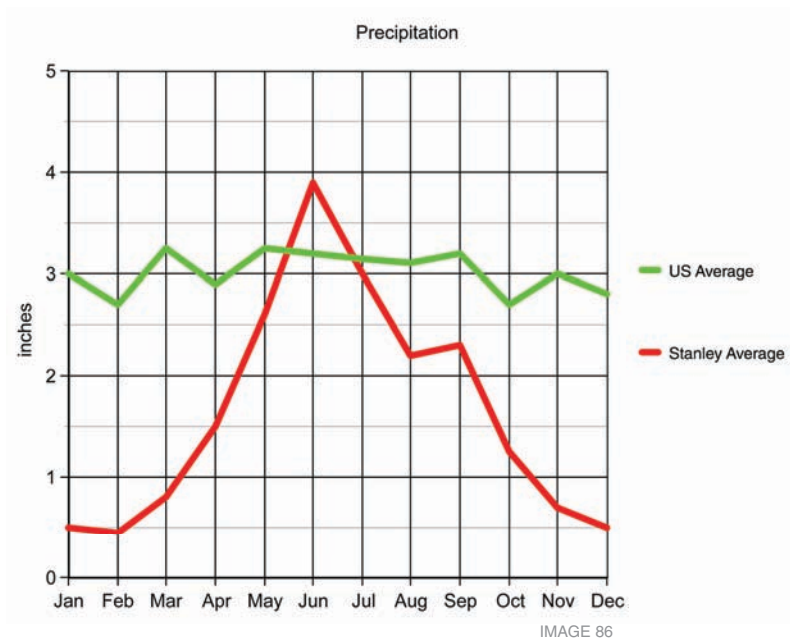
The graph depicts the average percentage of cloudy days per month in Stanley, ND.



ROOM ARODES

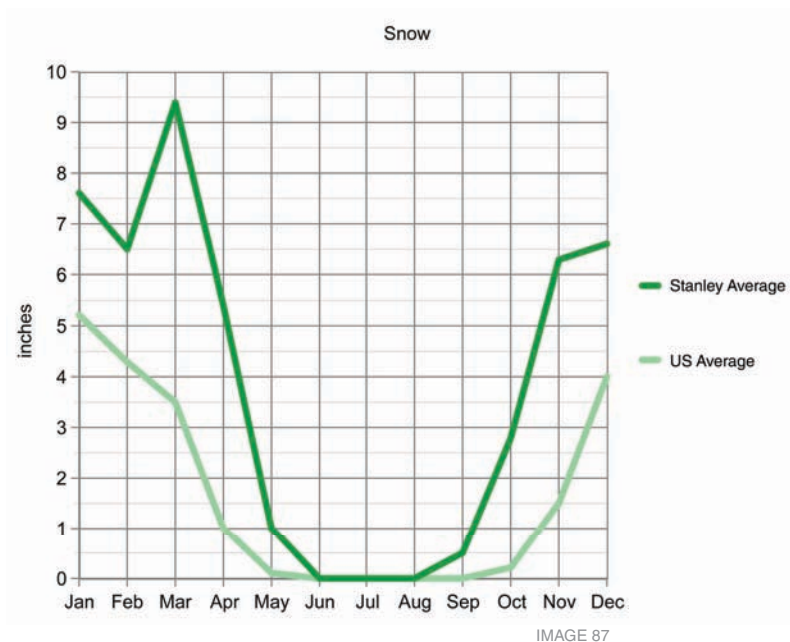
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Site Analysis



Precipitation

The graph depicts the annual average precipitation levels for Stanley, ND. The majority of precipitation falls during the warm period of the year and is typically heaviest in late spring and early summer. The total annual precipitation is about 18 inches.



Snow

The graph depicts the annual average snowfall for Stanley, ND compared to the U.S. average. In the winter the average temperature is 10 degrees F and the average seasonal snowfall is about 40 inches.

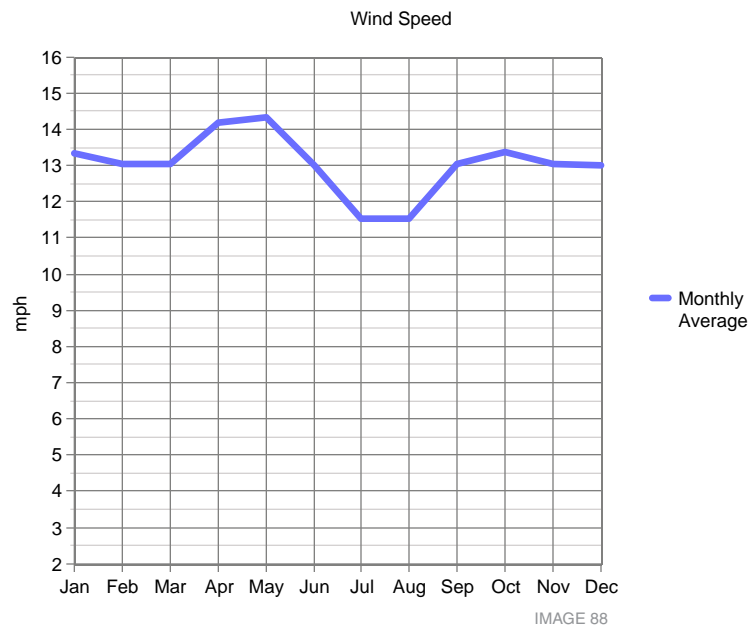
BOOM A BODES

designing for the transition

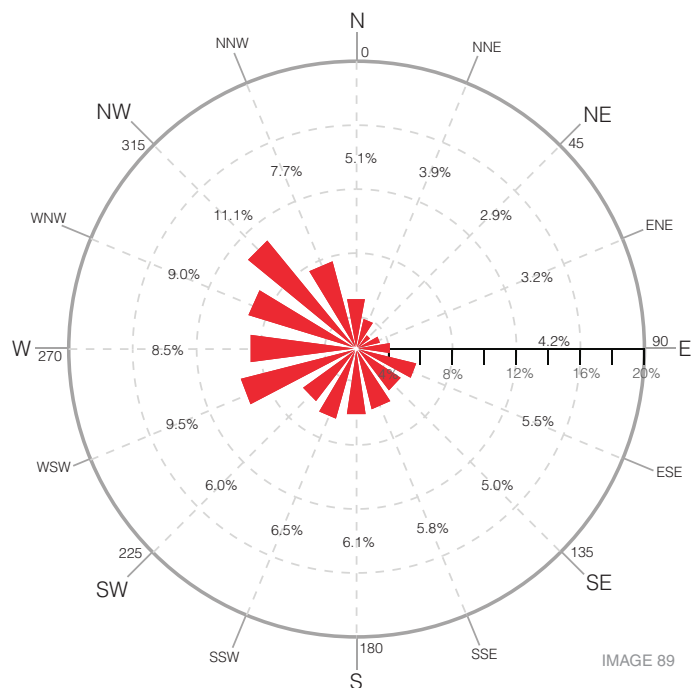
Site Analysis

Wind

The graph depicts the average monthly wind speed for Stanley, ND. The average wind speed is highest in the spring.

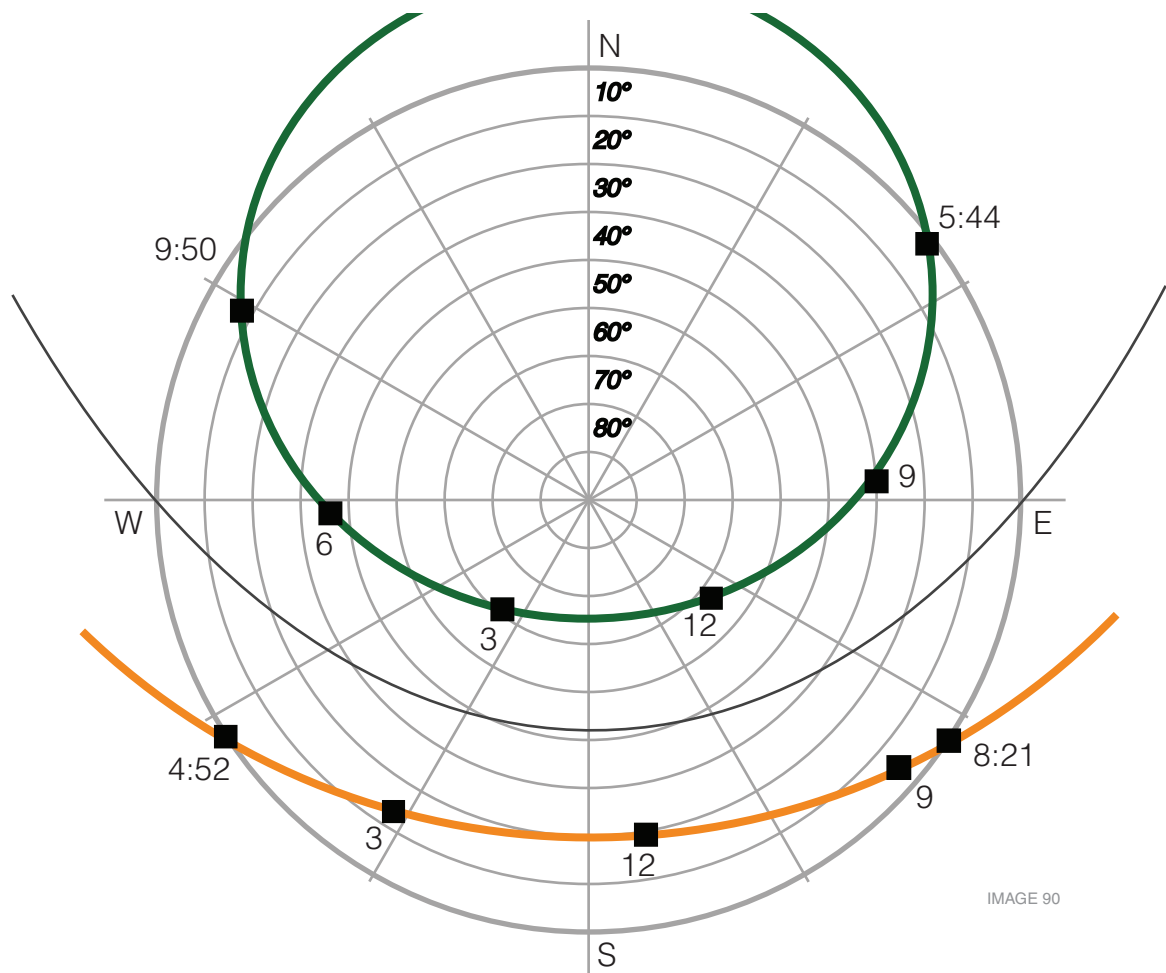


The windrose represents the speed of wind and the percentage of time the wind comes from a certain direction. In Stanley, ND the wind most commonly comes from the northwest, west-southwest and west-northwest.



Sun Path Diagram

The diagram presents the sun's relationship to the earth at varying points in the year. The green line represents the sun's path on the summer solstice, June 21. The thin black line is the sun's path around the earth on both the vernal and autumnal equinoxes. The orange line represents the sun's path on the winter solstice, December 21.



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thesis
program

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Thesis Program

The result of this thesis is a proposed solution to aid communities experiencing rapid population growth. The design is to be flexible so that it may adapt to a varying number of occupants. Close attention will be given to the construction and deconstruction process of the units as they need to be efficient in order to fully serve their purpose. The following figures are of one residential dwelling unit and additional community components.

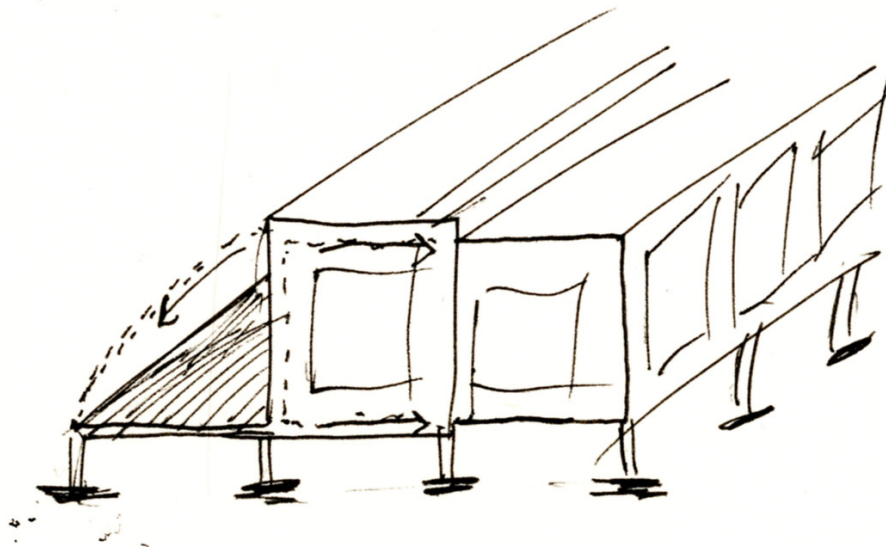
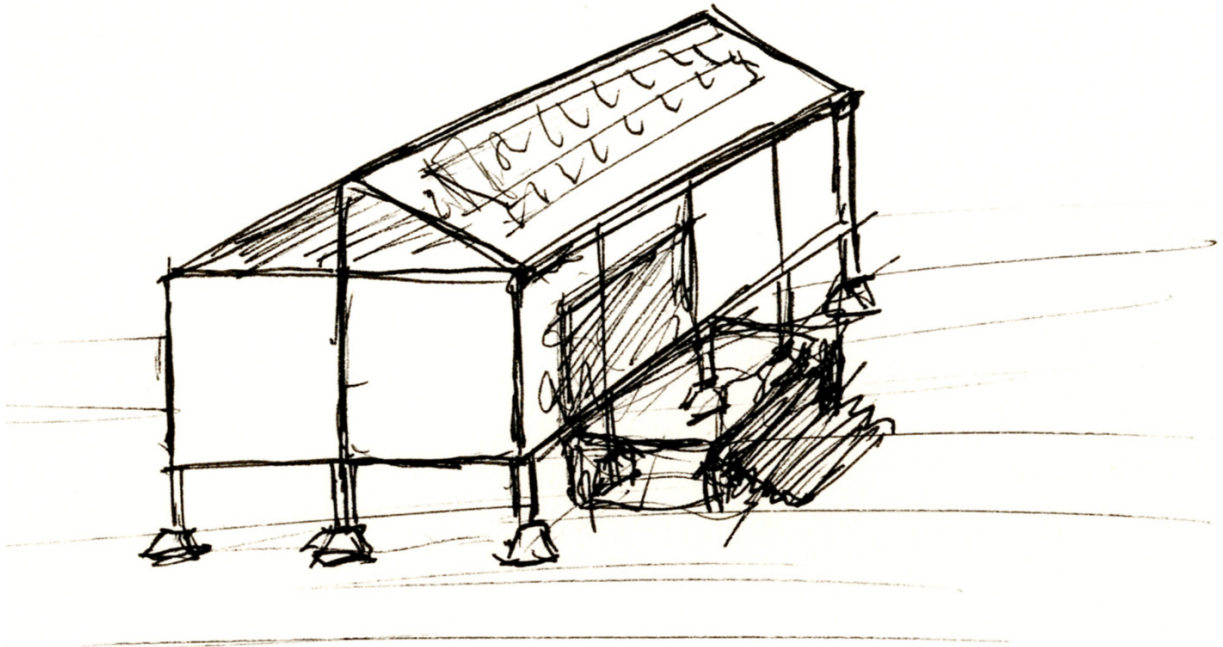
Residential Dwelling Units	1040sf
Portable Living Unit	480 sf
bedrooms	288sf
kitchen	176sf
bathroom	64sf
living area	192sf
flex space	288sf
mechanical	32sf
Community Parks	160,000sf
Multi-purpose Community Buildings	12,000sf
Community Management Office Building	10,000sf
Community Maintenance Building	15,000sf
Wastewater and Sewage Treatment Units	160sf each

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process
documentation

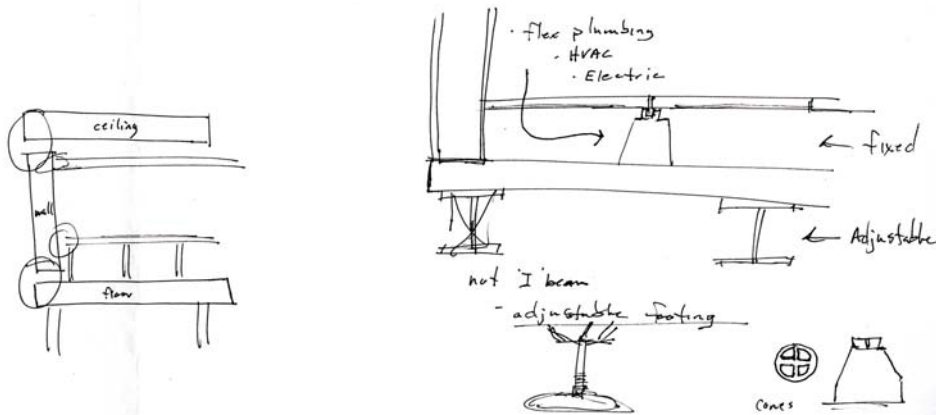
ROOM ARODES

designing for the transition *Process Documentation*

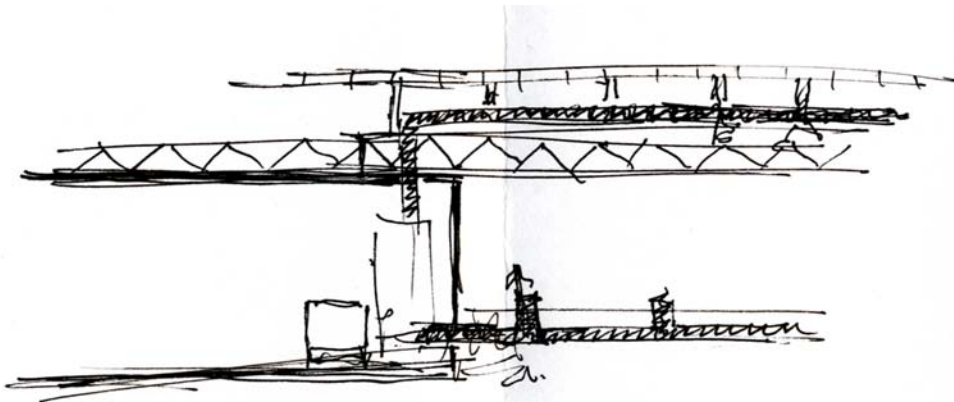
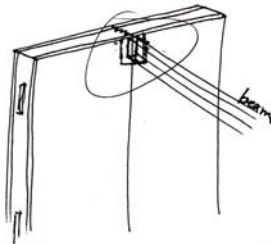


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Structure for Roof - attachment of beam at
point of panel connection
- detail design
- strong-tie



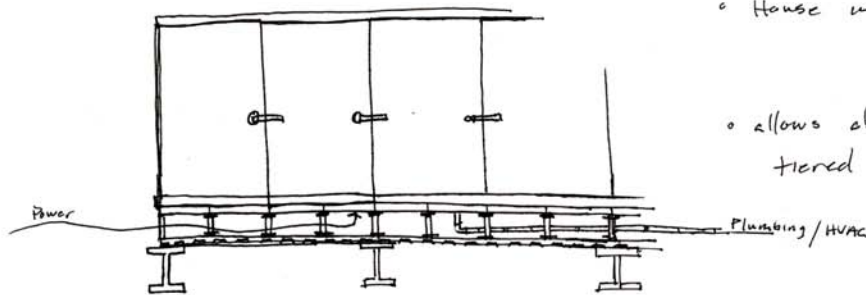
ROOM ARODES

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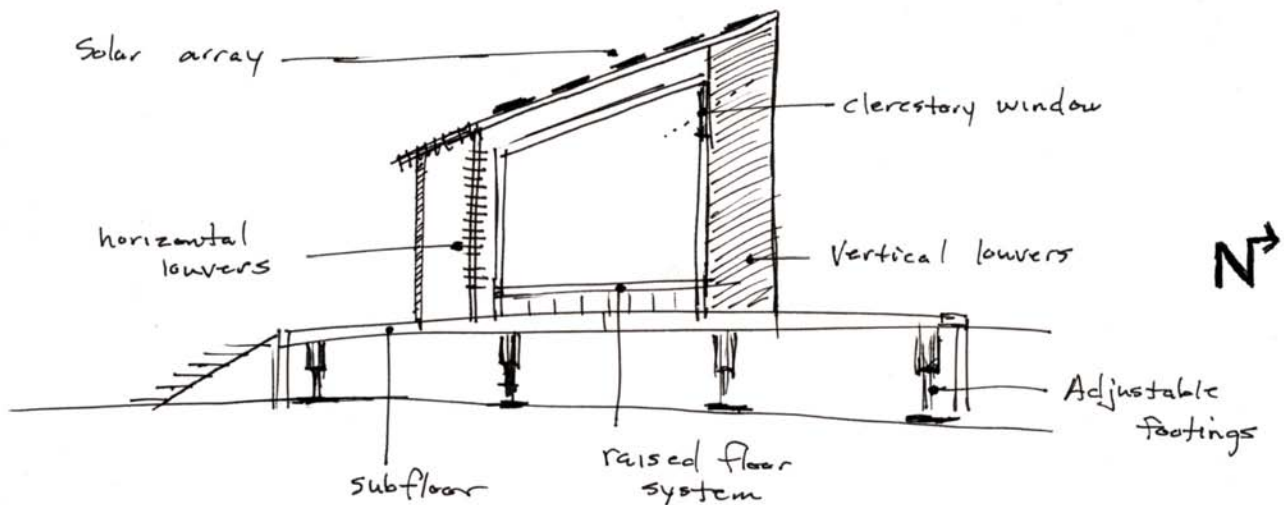
RAISED FLOOR SYSTEM

- * raised 5 to 30 inches above the standard floor
- House wires, pipes, HVAC



- allows ability to create tiered levels

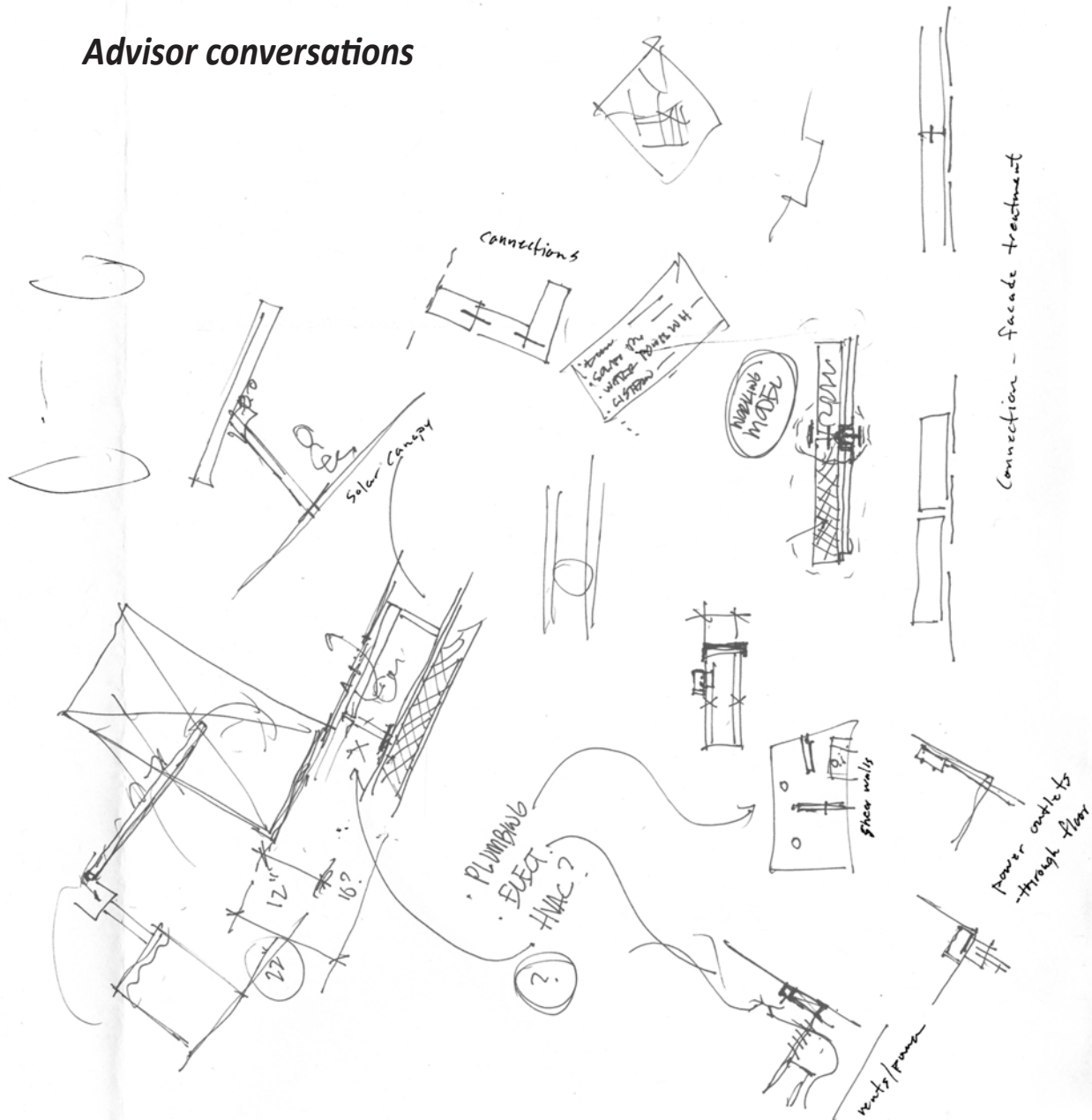
- Sub-floor supported by adjustable footings which anchor to the ground
- adjustable footings allow flexibility to multiple terrains



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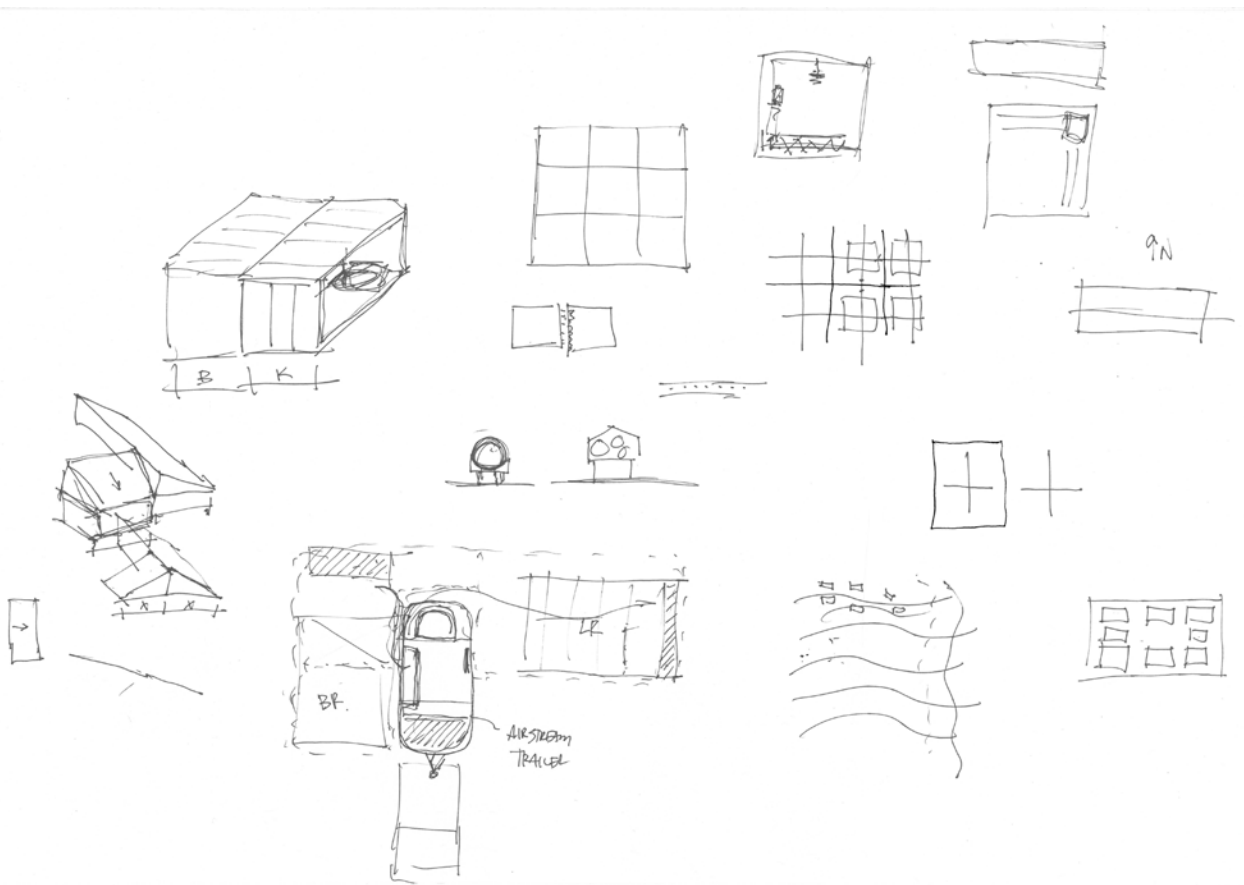
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Advisor conversations



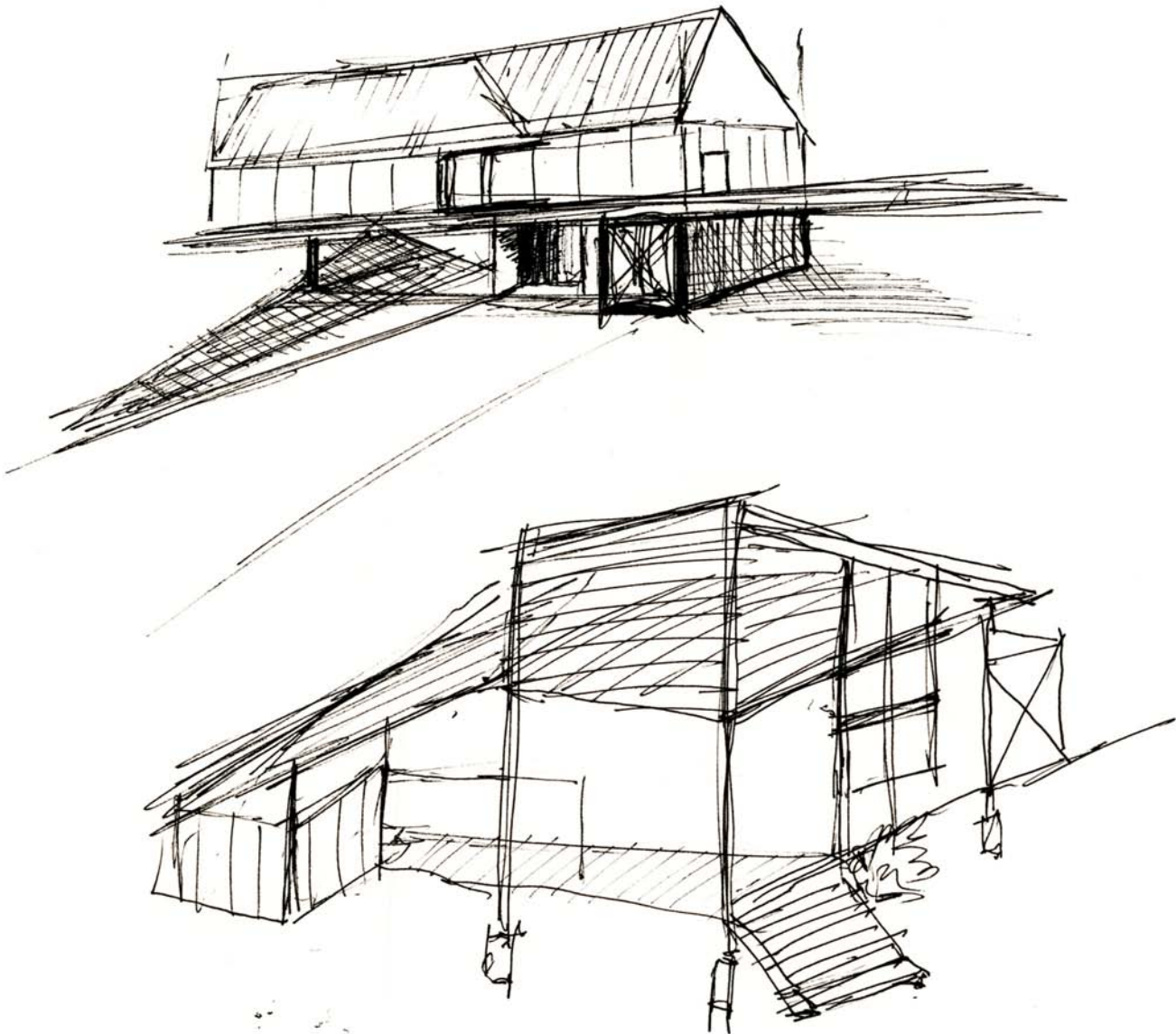
designing for the transition

Process Documentation



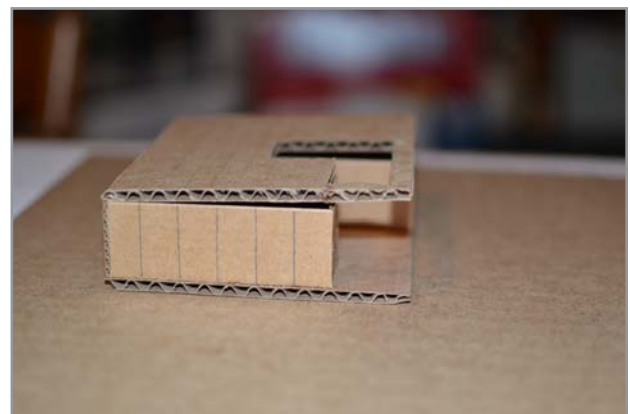
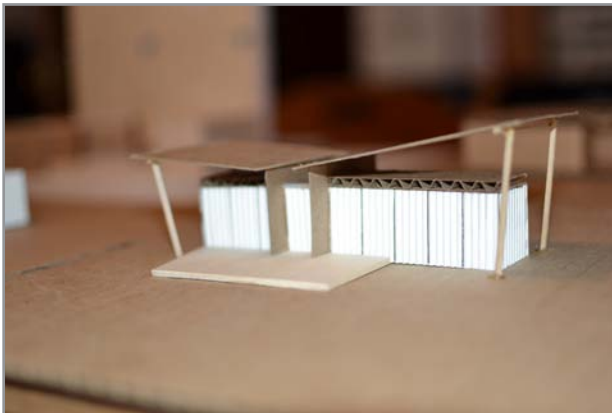
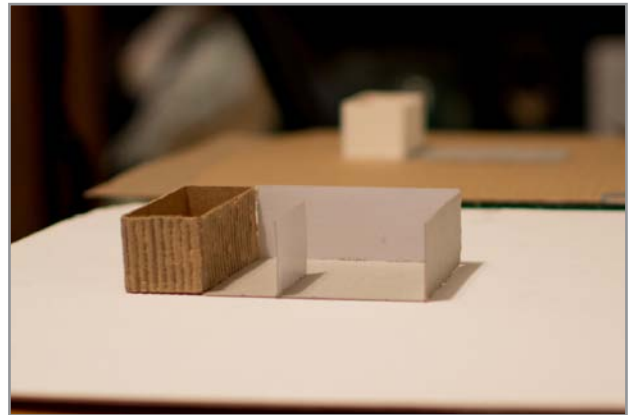
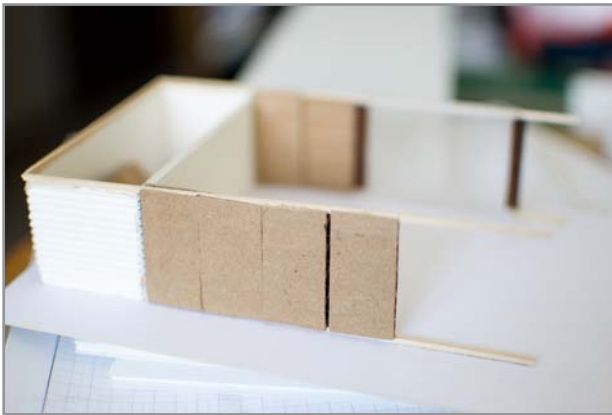
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project solution
documentation

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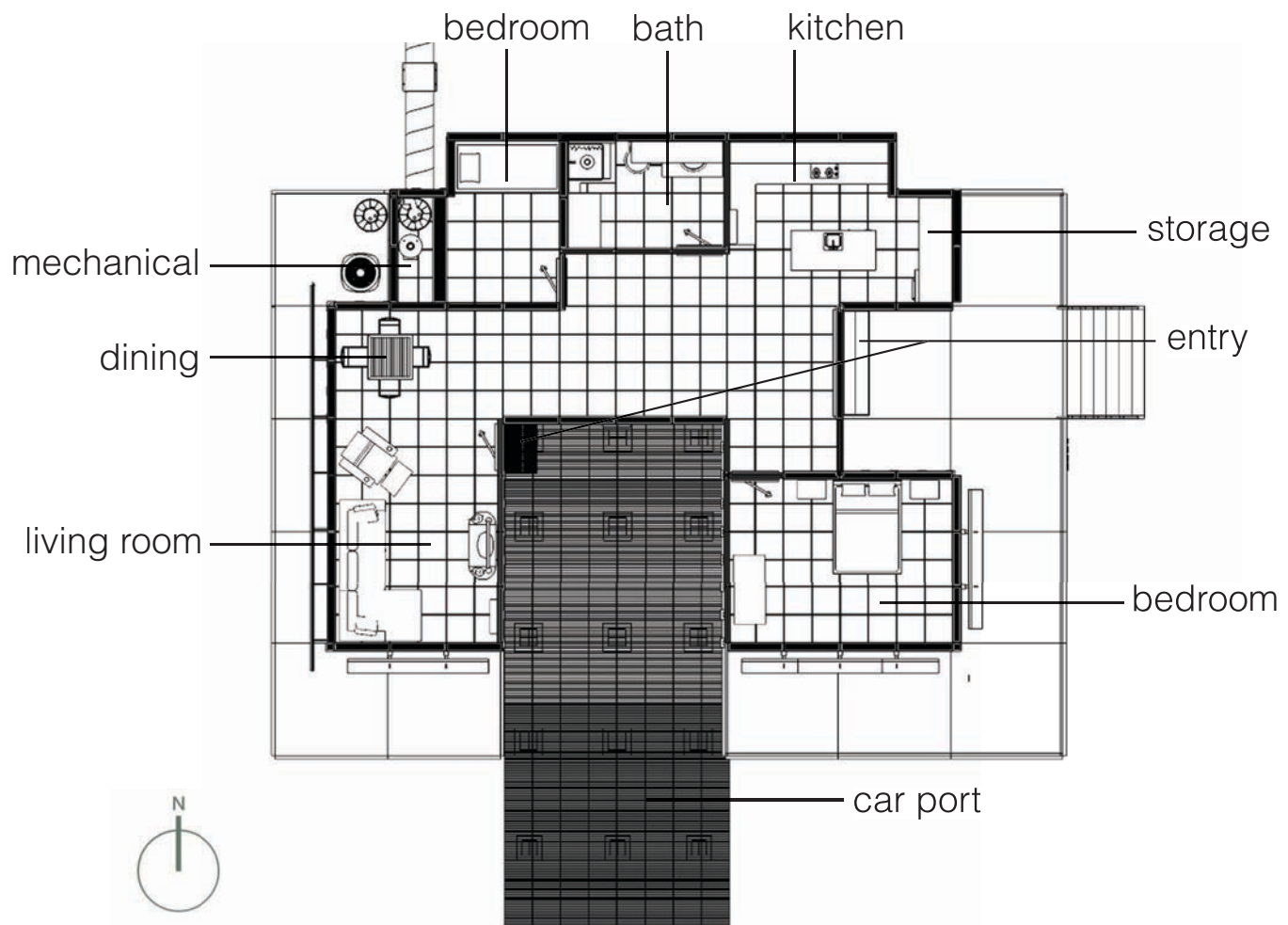
designing for the transition *Project Solution*



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Family Unit Plan



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designing for the transition *Interior Perspectives*



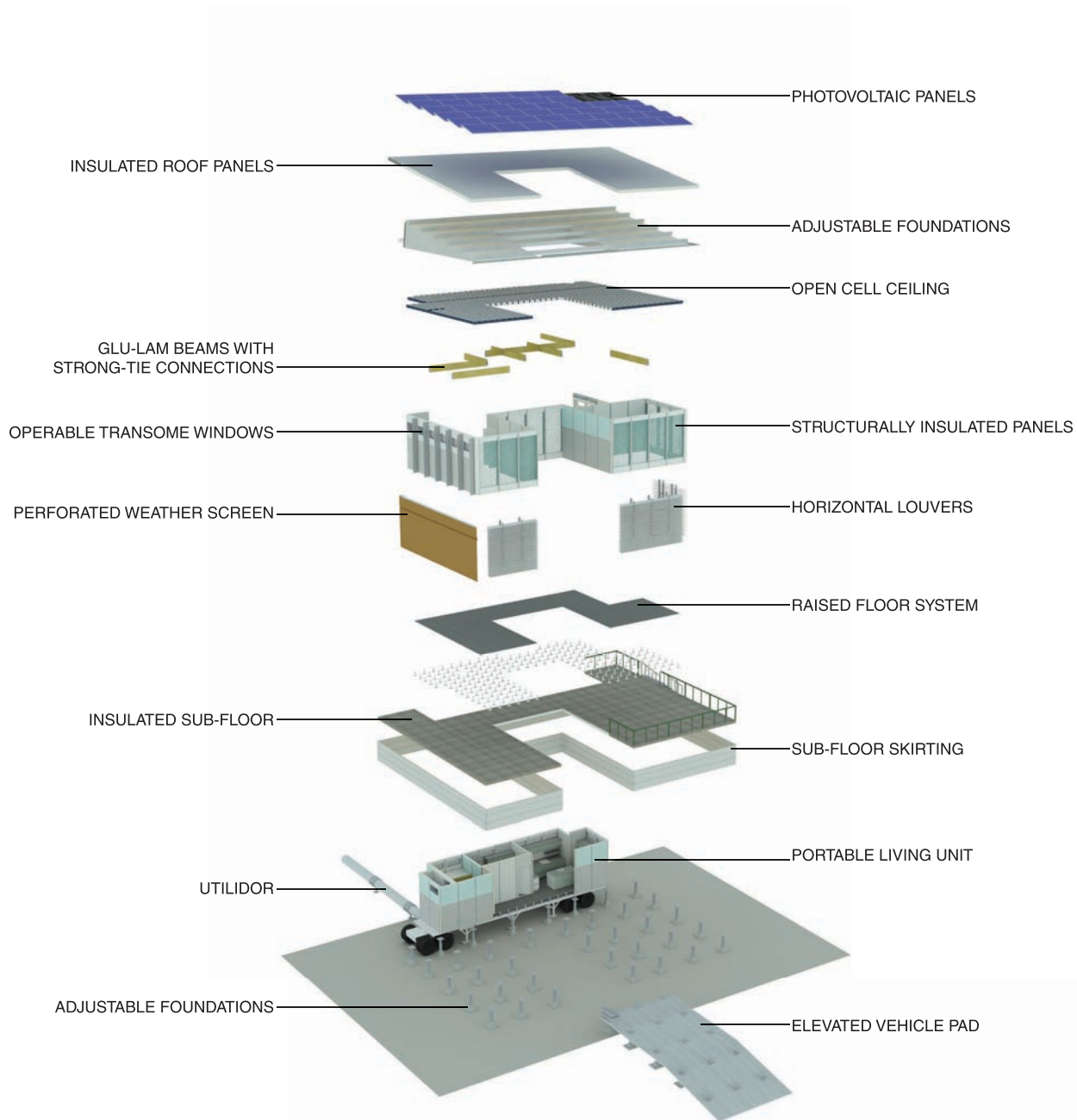
living room



kitchen

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Section Perspective



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designing for the transition *Portable Living Unit Plan*

Portable Living Unit Collapsed



Portable Living Unit Expanded

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designing for the transition *Portable Living Unit*

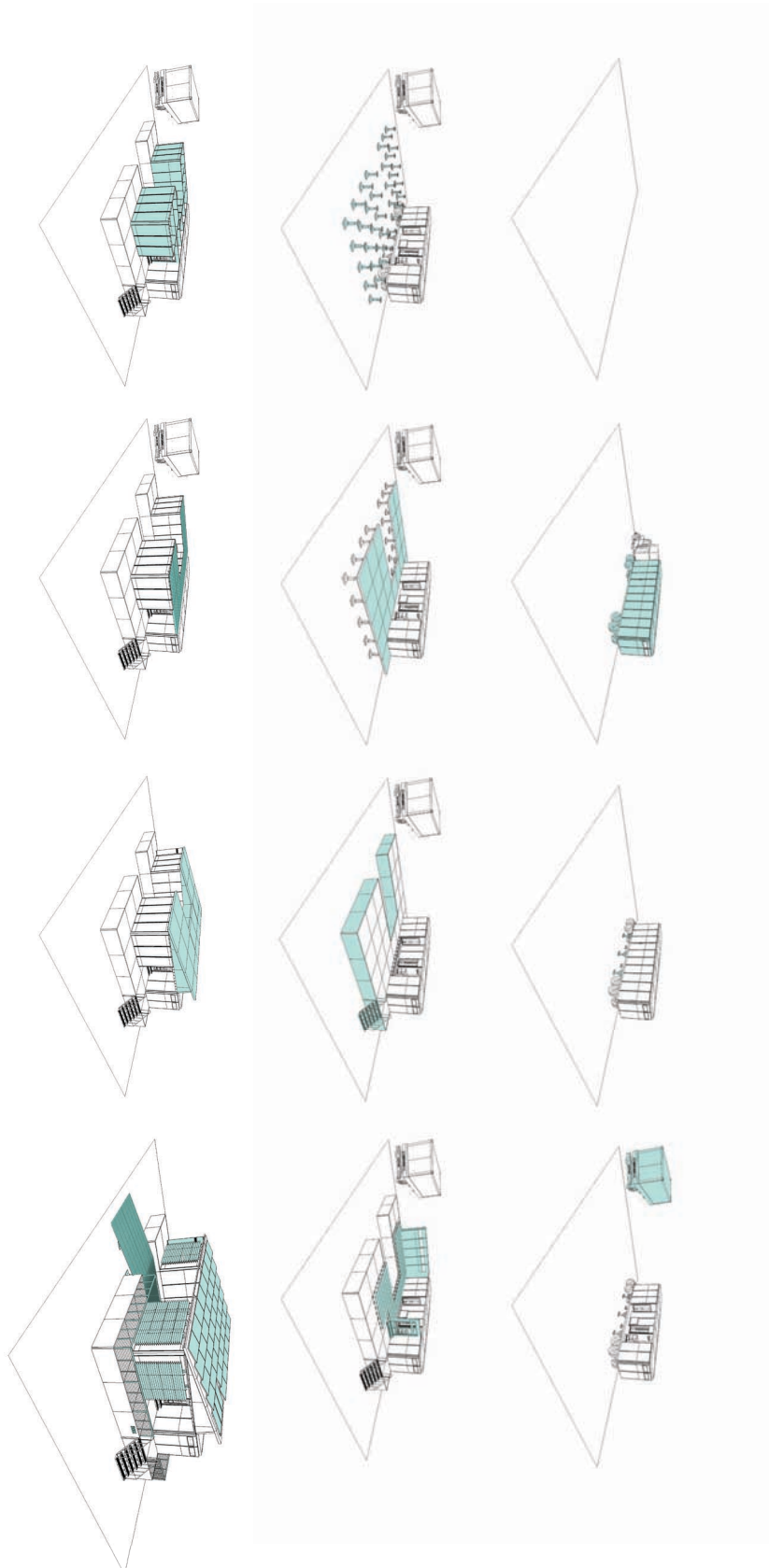


pex plumbing - pex tubing is flexible allowing the freedom to run pipes anywhere in the house

utilidor - an above ground plumbing system that carries and insulates pipes

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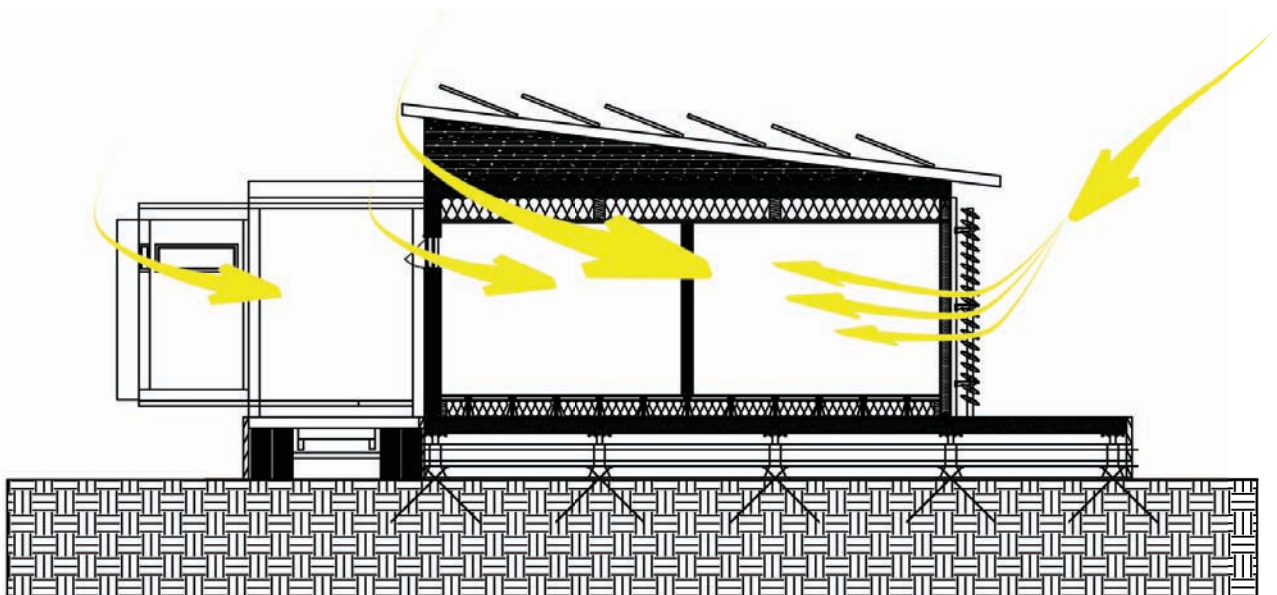
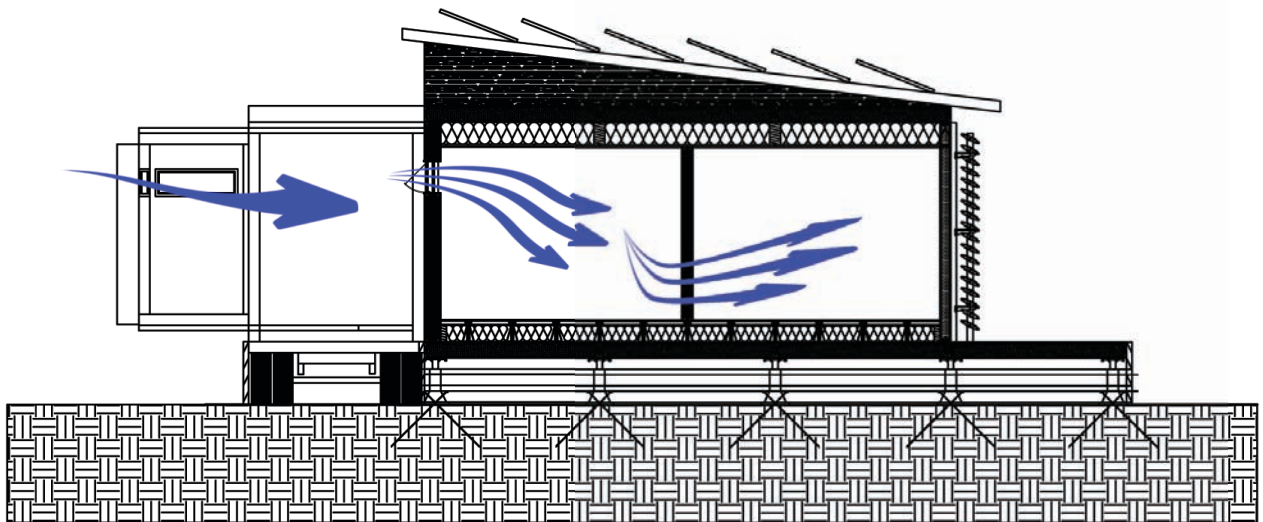
designing for the transition *Construction Sequence*



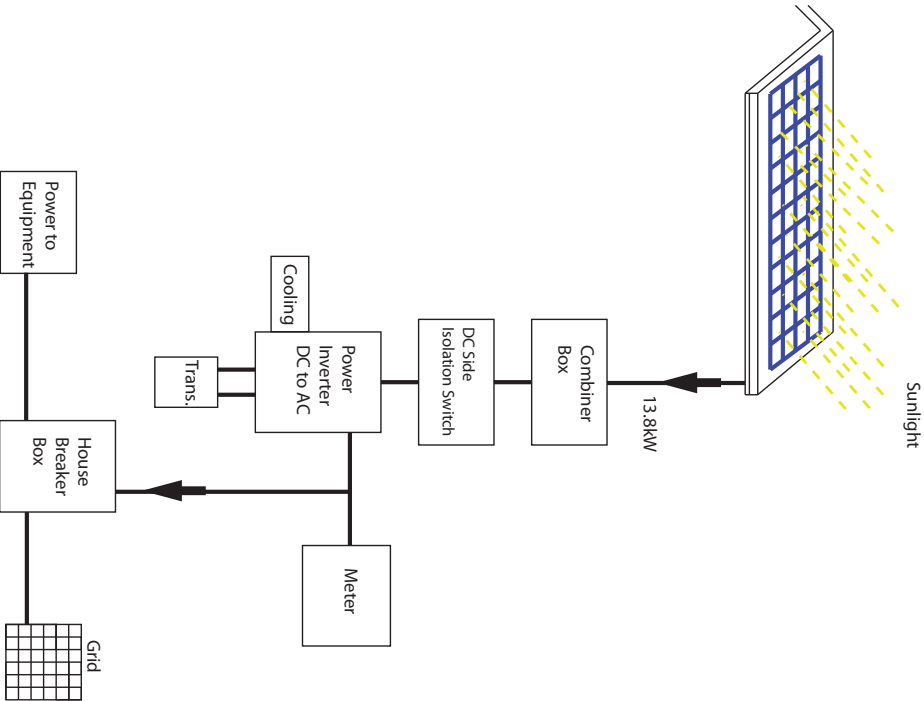
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Passive Ventilation & Daylighting



ROOF COLLECTION AREA:	1,344sf
SOLAR COLLECTION:	<p>230W Solar Photovoltaic Module Polycrystalline silicon cells BP3210T</p> <p>1,344sf collection area divided by 17.5sf/panel = 60 panels x 230W/panel = 13,800W (13.8 kW)</p> <p>Average production for 5 hours per day 13.8kW x 5hrs x 365days = 25,185 kWh/yr.</p>
Annual electricity usage:	<p>Household average per month = 1,150 kWh 1,150kWh x 12mo. = 13,800 kWh/yr.</p>
PRODUCTION:	<p>25,185 kWh/yr. = 182% of consumption</p> <p>Excess AC power generated is sold back to the grid and used by the utility company. The house will use electricity from the city grid during non-solar harvesting times.</p>



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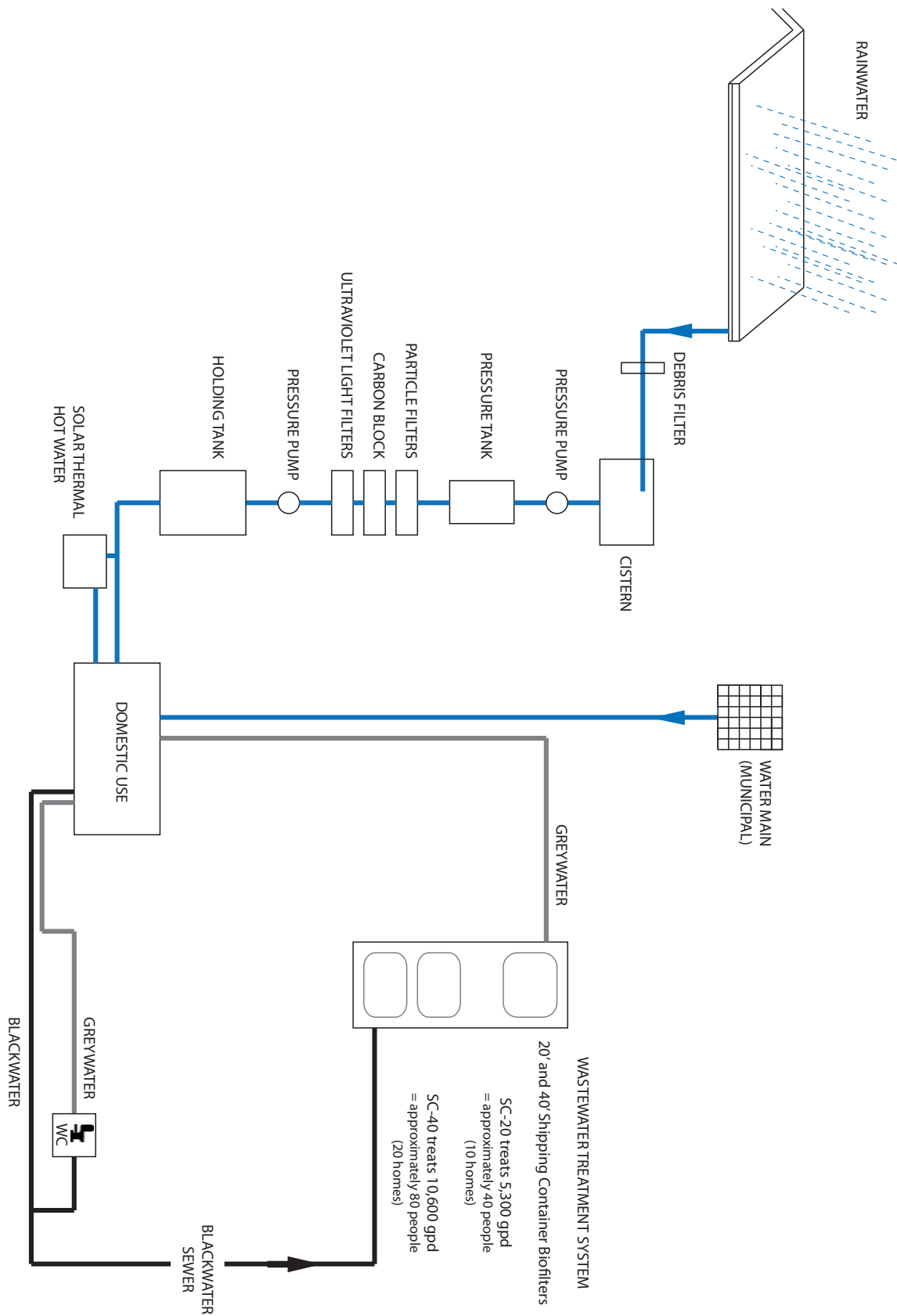
Rainwater Harvesting

Average precipitation:	18"/ year					
Collection roof area:	1,600 sf					
Water collection:	SF	x	inches/year	x	0.5618	= gallons/year
	(footprint)				(in. to gal.)	
	1,600 sf	x	18"/yr.	x	0.5618	
	=		16,180 gallons/year			
	divided by 52 weeks					
	=		311 gallons/week available			
	5 months draught (<1in. rainfall)					
	x 4 weeks/month					
	= 20 weeks					
	x 311 gallon/week budget					
	= 6220 gallon supply for draught					
Consumption:	29.5 gallons/day average per person					
	x 4 people per household					
	= 118 gallons/day					
	118 gallons/day	x	365 days			
	= 43,070 gallons/year consumed					
	16,180 gallons/year collection	=	37% of consumed water			

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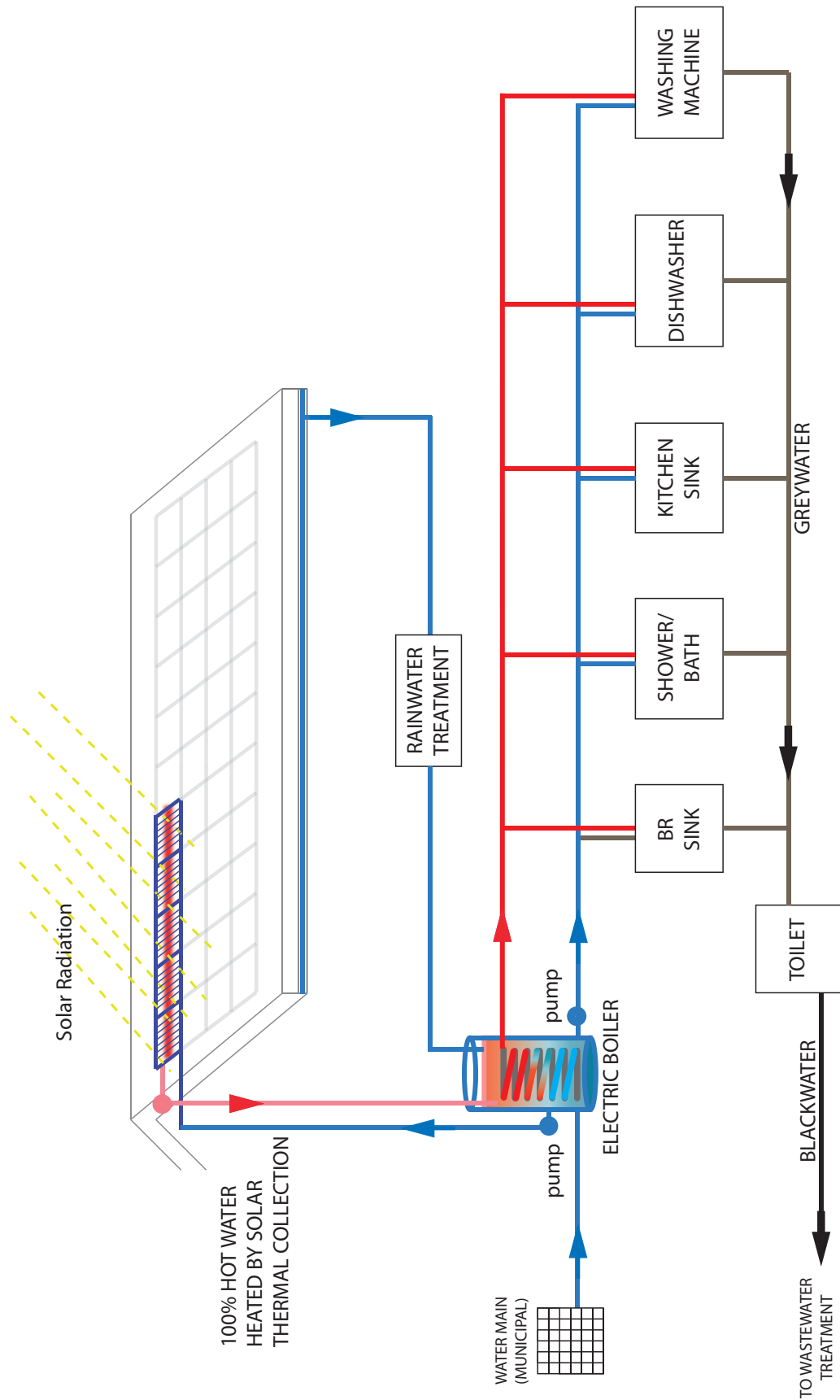
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Rainwater Harvesting



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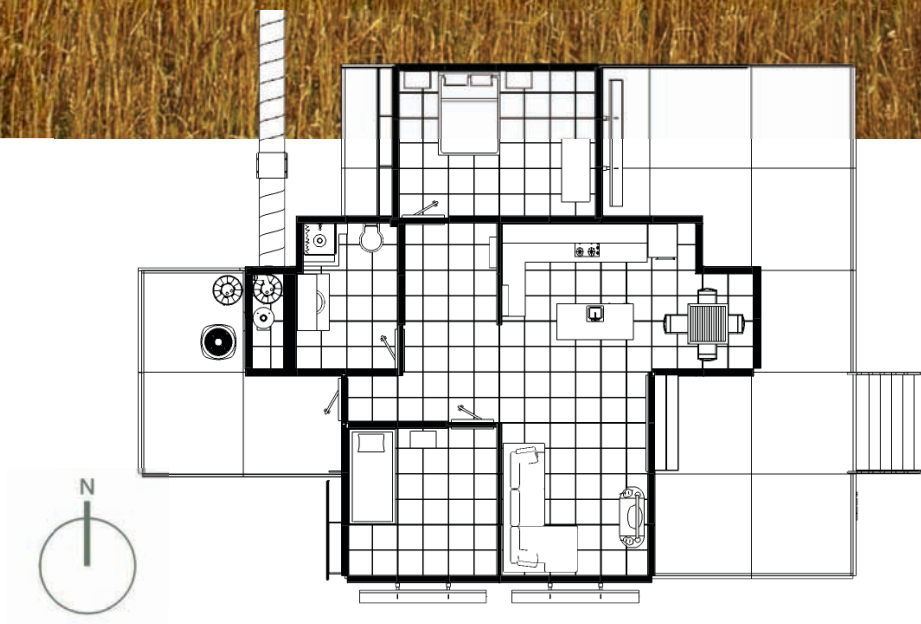
designing for the transition *Solar Hot Water System*



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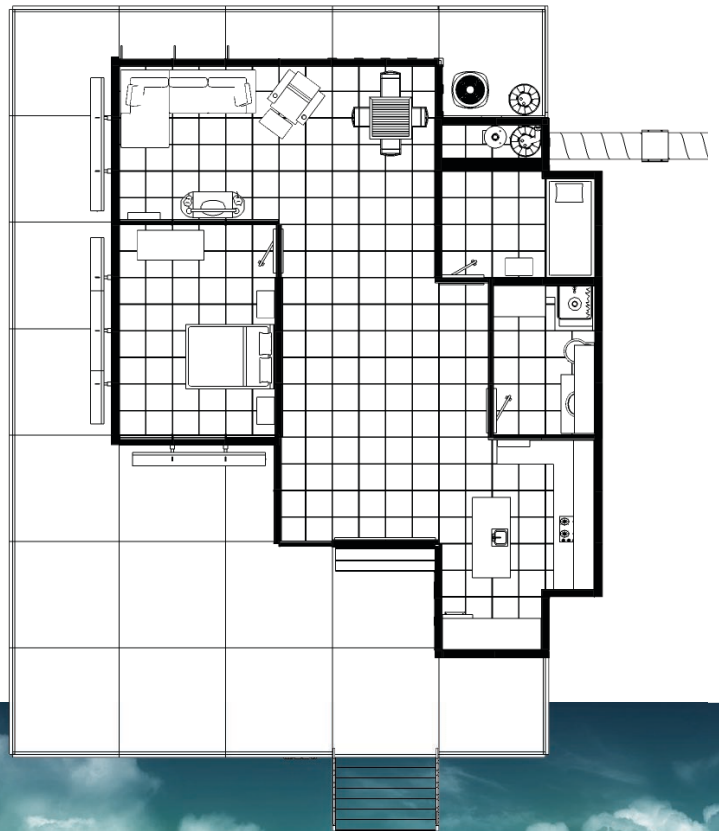
Family Unit



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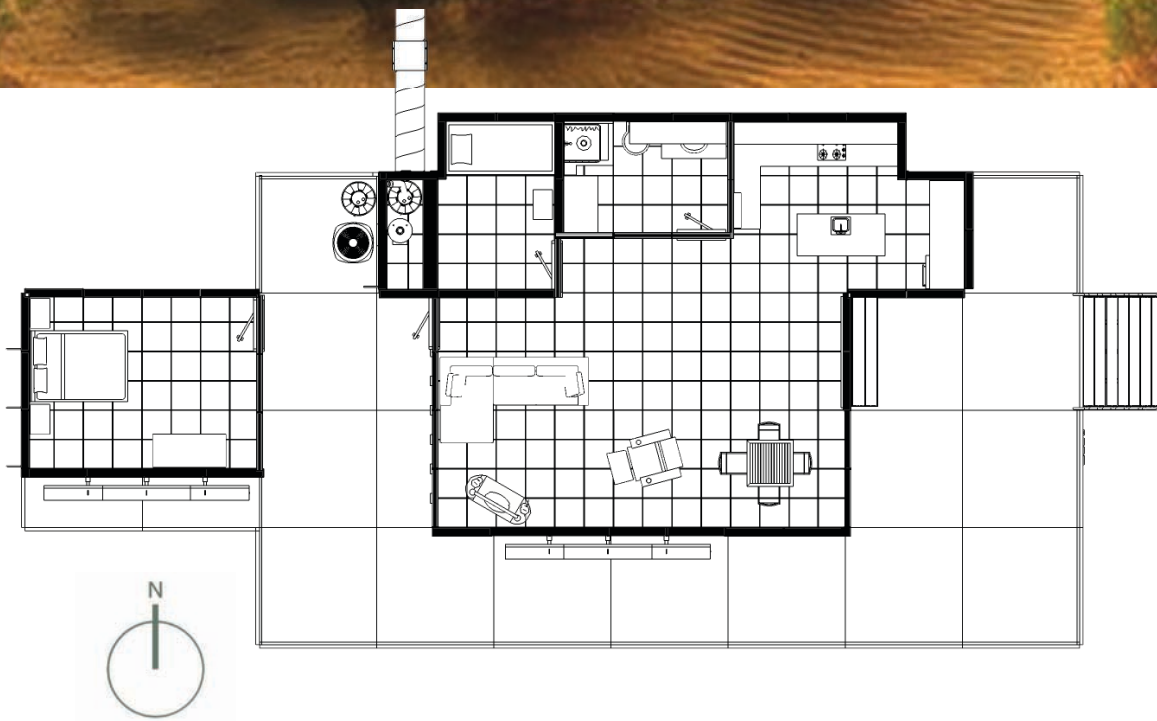
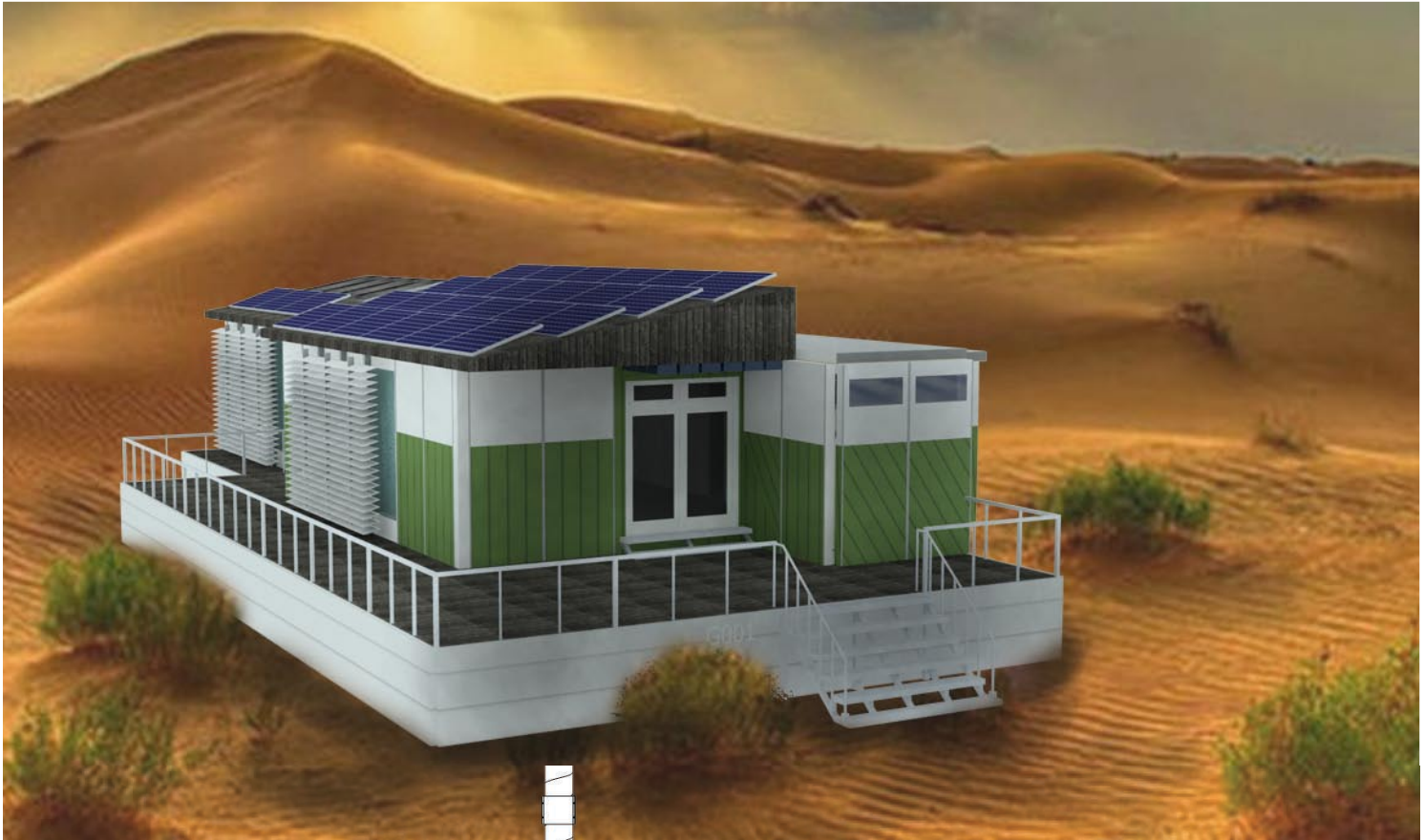
Family Unit



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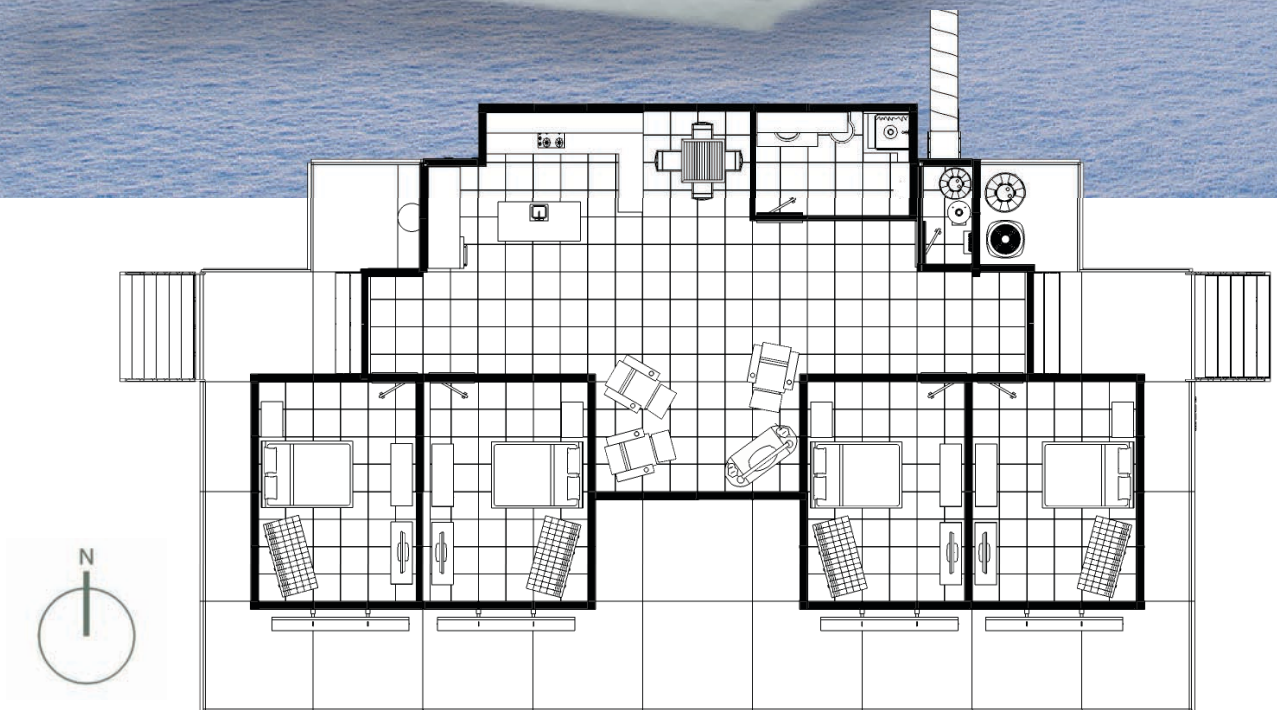
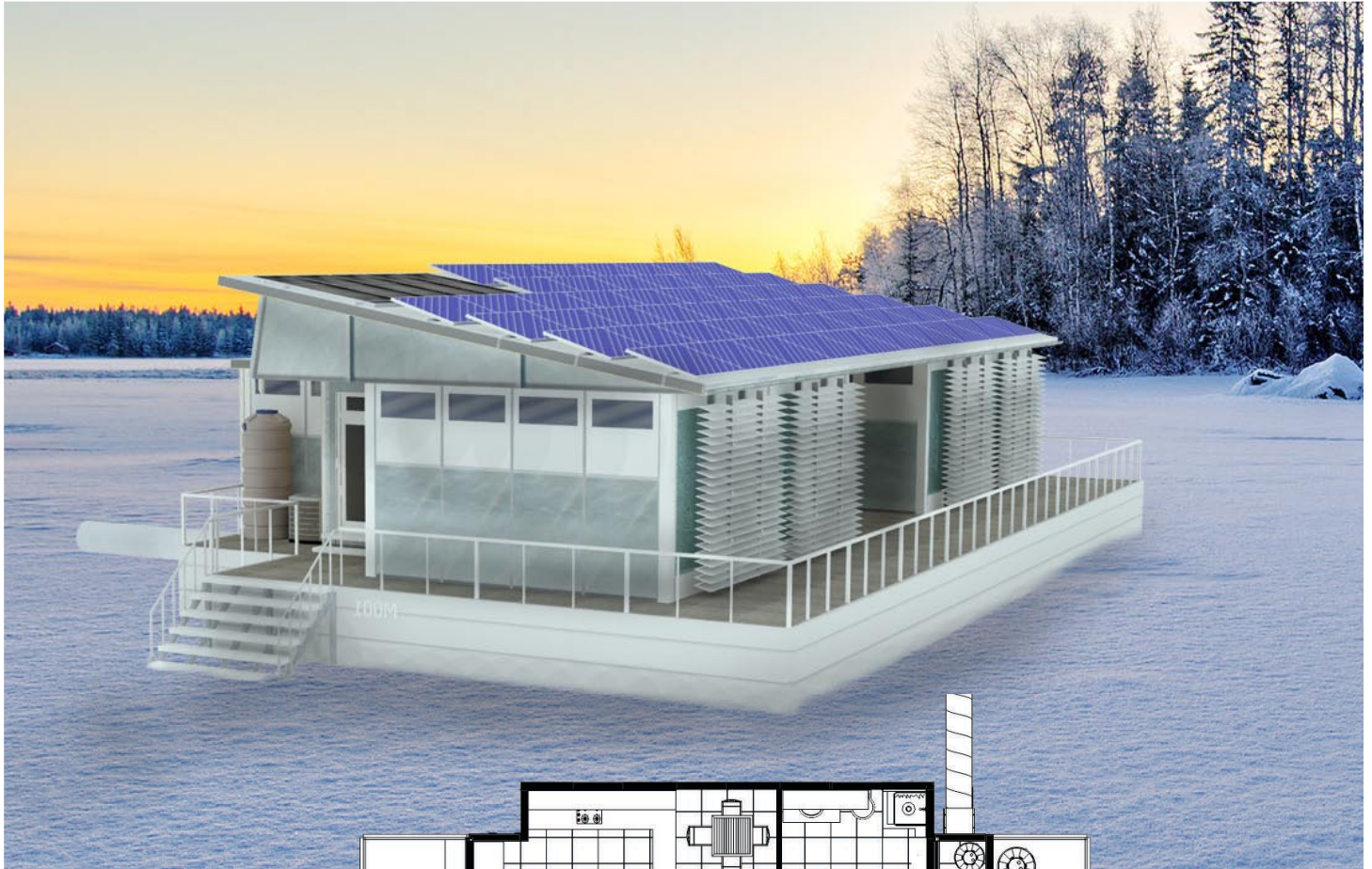
designing for the transition

Family Unit



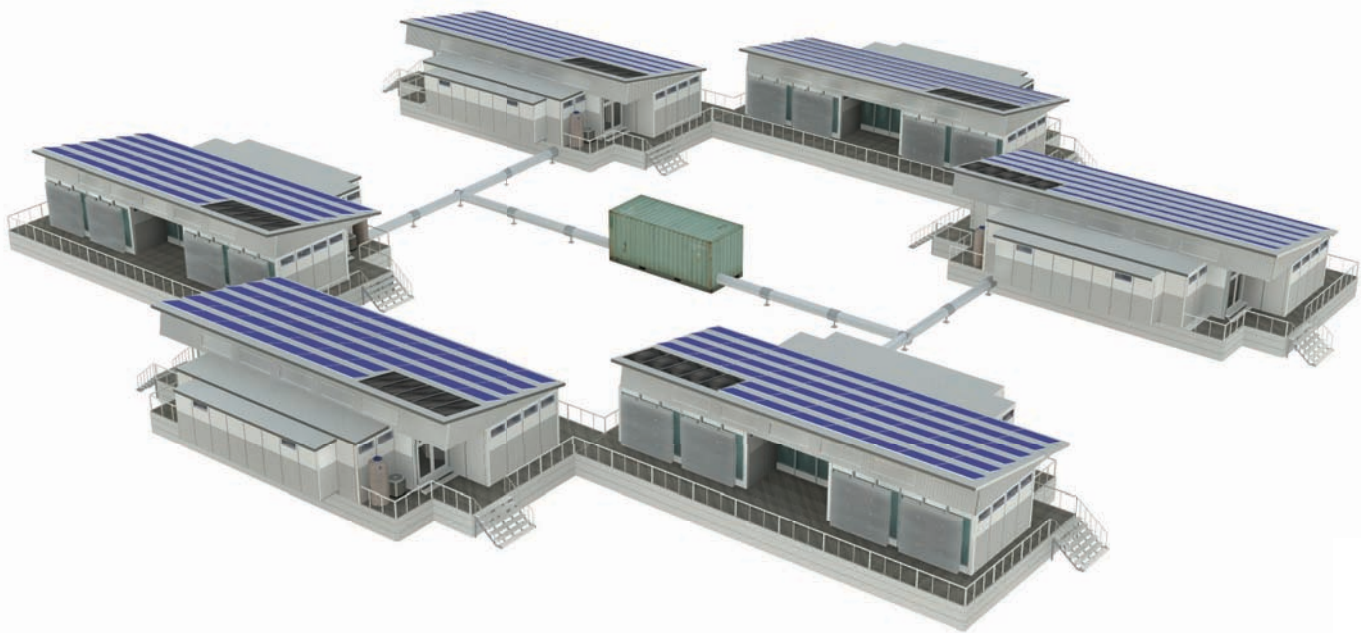
ROOM ARODES

designing for the transition *Workforce Unit*



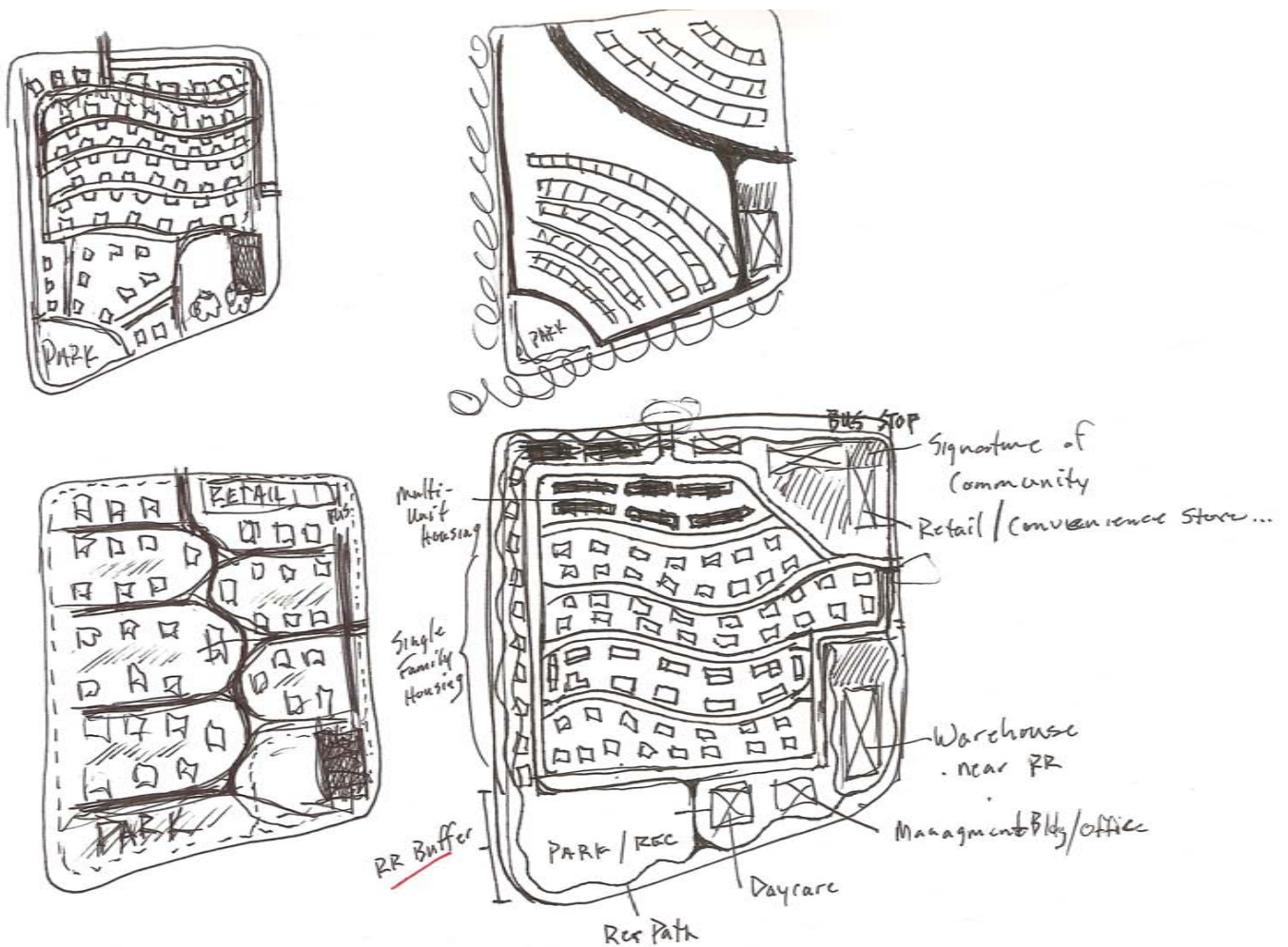
ROOM ABODES

designing for the transition *Workforce Unit*



ROOM ARODES

designing for the transition *Community Layout*



ROOM ABODES

designing for the transition *Community Layout*

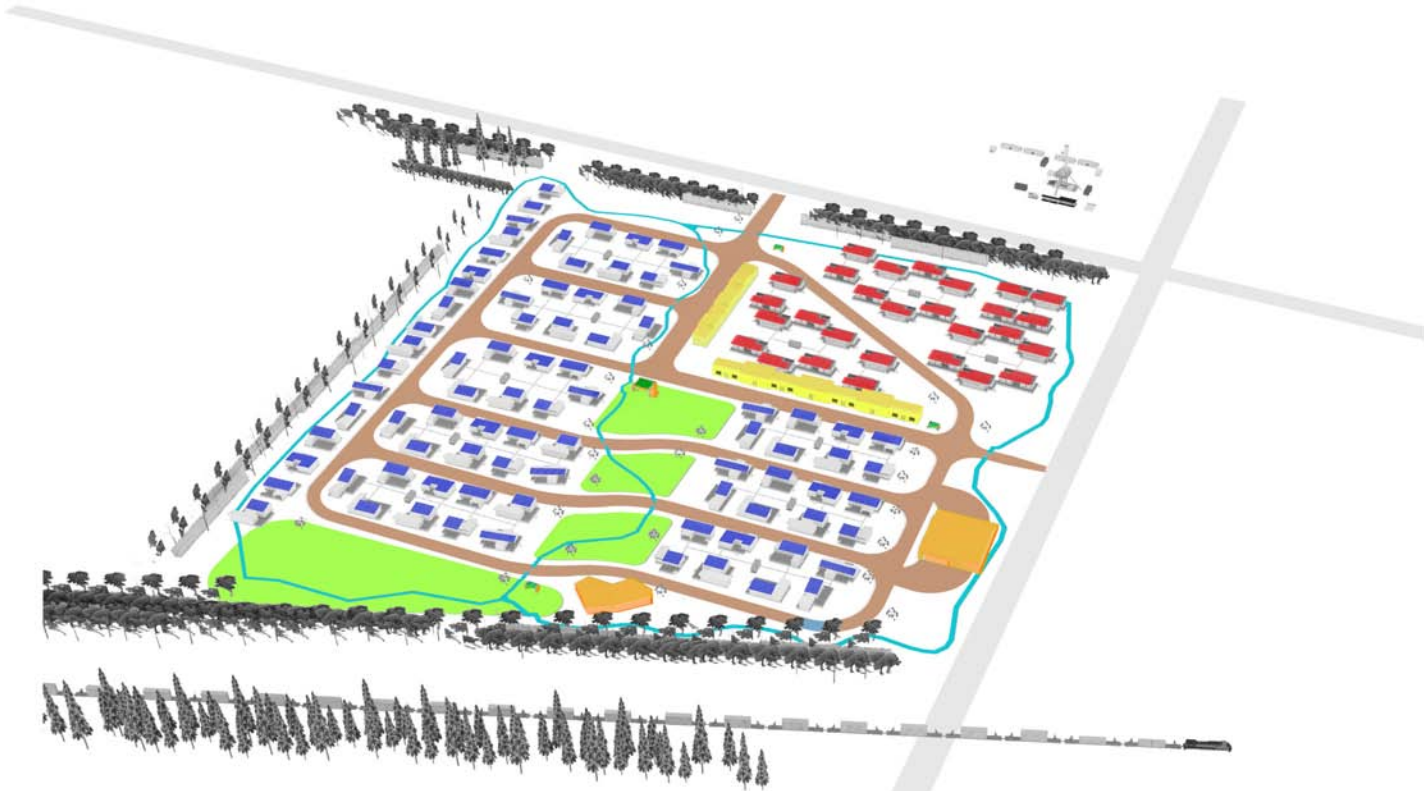


- family units
- workforce units
- multi-purpose buildings
- additional structures
- community parks
- community circulation

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Community Layout



- The family units are oriented on the site to create interior courtyard spaces and direct access to a road.
- Each group of units is supported by a water treatment module placed within the courtyard.
- Located at the northeast corner of the site, the workforce units are provided easy access to both entrances, thus minimizing disturbance to the rest of the community.
- The multi-purpose buildings are oriented on site to create separation between family and workforce units. They also create job opportunities for the community residence.
- The community management offices include a day-care adjacent to the large community park.
- The maintenance building stores vehicles and additional building components.
- Bus stops provide transportation options and solar powered street lights provide safety and security.
- Four large community parks create spaces for a variety of outdoor activities.
- The roads allow for efficient delivery of units and are paved with gravel or scoria. A recreation path winds throughout the community.

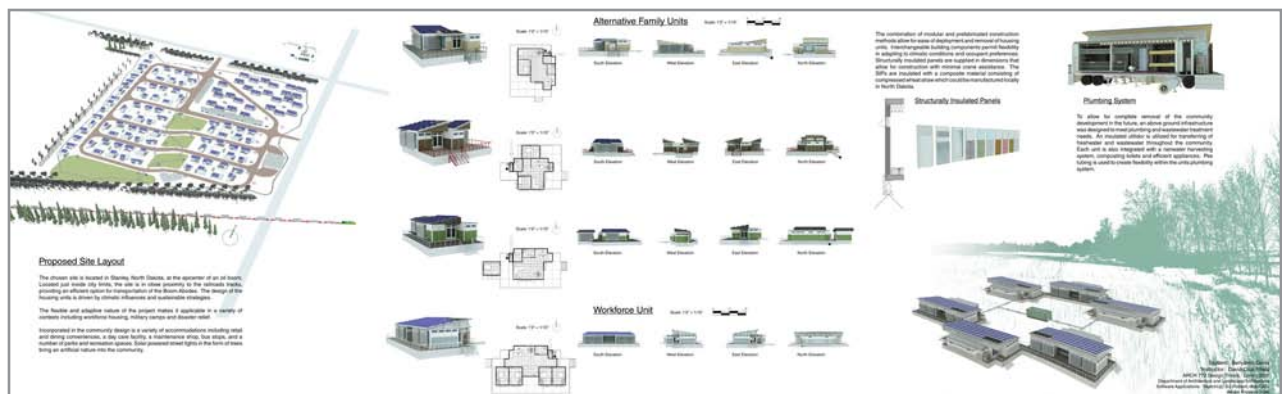
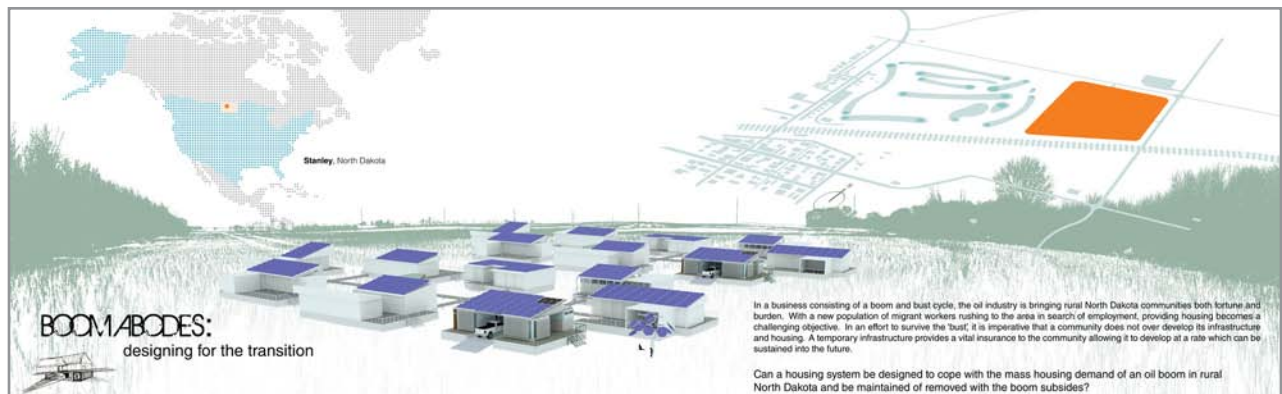
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presentation
display

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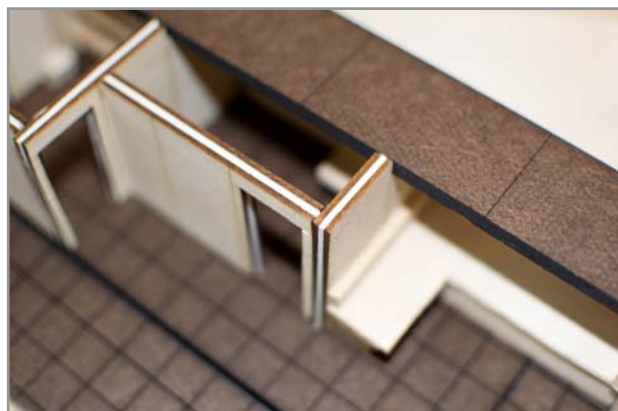
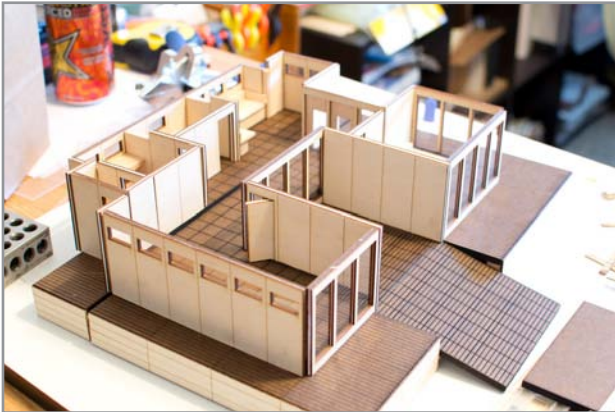
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Presentation Boards



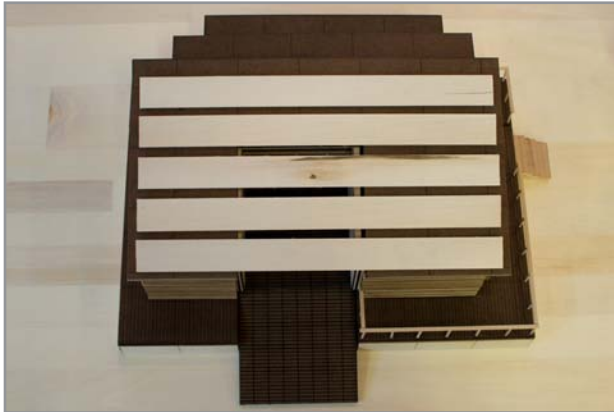
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designing for the transition *Presentation Models*



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Presentation Display



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image **references**

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Image References

IMAGE COVER

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IMAGE 1-4

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IMAGE 5-10

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IMAGE 11-21

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IMAGE 22-36

Green Horizon. (2010). Retrieved November 10, 2010, from <http://greenhorizonmfg.com>

IMAGE 37-46

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IMAGE 47-52

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IMAGE 53

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IMAGE 54-57

Digital Horizons. (2010). Retrieved November 29, 2010, from <http://digitalhorizonsonline.org>

IMAGE 58-61

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IMAGE 62

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IMAGE 63-73

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IMAGE 74

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IMAGE 75

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IMAGE 76

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IMAGE 77, 78

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IMAGE 79

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IMAGE 80, 81

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IMAGE 82-88

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Image References

IMAGE 89

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IMAGE 90

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identification

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about facilitating a better future.'**

